AN INVESTIGATION OF THE STRUCTURE OF A HOSPITAL INFORMATION AND DECISION SYSTEM

By

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This research is directed at providing additional understanding of the hospital information and decision system and as such serves as a basis for further analysis and development of an automated hospital information system.

The basic activities and informational requirements of the general hospital are isolated and classification schemes applied to them which aid in characterizing and defining the information and decision system. The total hospital system is divided into functional subsystems and the desirability of integrating decision-making and information retrieval techniques into this basic system is stressed. Finally, the basic framework for an automated hospital information system is proposed and the logic of its structure developed.

CHAPTER I

INTRODUCTION

The modern hospital plays a significant role in the life of the American public. The effect on the economy of the country is in itself enough to place the hospital in its important role on the national scene. The 1965 Guide Issue of Hospitals (10) states that over 7000 hospitals in the country employ over 1.8 million persons, excluding doctors, and have total expenditures of over 12.0 billion dollars every year. Of even more significance to those requiring care is the hospital's patient care function. Georgopoulous and Mann (7) found that the average American spends a day of each year inside a hospital and over 95 per cent of all babies born in the country are now delivered in hospitals.

Objectives of the Hospital Organization

It is this function of patient care that provides the very basis of existence for most hospitals. All hospitals, according to Georgopoulous and Mann (7) ". . . are concerned with the same general objective--that of providing adequate patient care effectively." There exist associated objectives of the modern hospital, but each is concerned with patient care in the long run.

MacEachern (14) states:

> The functions of the modern hospital are essentially four: a) care of the sick and injured; b) education of physicians, nurses, and other personnel; c) public health--prevention of disease and promotion of health; d) advancement of research and scientific medicine.

Georgopoulous and Mann reiterate the presence of:

> . . . additional objectives, including the hospital's own maintenance and survival, organizational stability and growth, financial solvency, medical and nursing educational research, and various employee-related objectives, all of which are subsidiary to the key objective of service to the patient.

Environment of the Organization

Georgopoulous and Mann suggest that:

> The typical hospital is an organization that mobilizes the skills and efforts of widely divergent groups of professional, semi-professional, and non-professional personnel to provide a highly personalized service to individual patients. The division of labor required by this wide range of skills makes co-ordination of effort vital to the operation of the hospital. Practically every person working in the hospital depends upon some other person or persons for the performance of his own organizational role.

The communication and co-ordination necessary to bring these divergent skills together comprises a significant portion of the hospital's total operation.

A means of accomplishing this co-ordination takes the form of the hospital's information system. This system is comprised of a set of activities working together toward a common goal. The information system is thus the link between activities within the hospital, providing information to these divergent activities in an effort to co-ordinate them in achieving the overall objectives of the hospital. This information system is rather formalized and subject to mechanization even though

Georgopoulous and Mann suggest that the ". . . hospital is a human rather than a machine system and does not yet include many functions that automatically handle the processing of its work."

The trend of hospital costs, especially personnel costs, makes mechanization of the information system particularly inviting. The 1965 Guide Issue of Hospitals states that total expenses for hospitals rose from 8.4 billion dollars in 1960 to 12.0 billion in 1964. During this same period personnel expenditures rose from 5.6 billion to 7.9 billion dollars. Georgopoulous and Mann further suggest that:

> While the public may be willing to pay for these essential costs of hospital care, it also expects the best care possible at reasonable cost or even at least cost. It is neither willing to tolerate nor prepared to pay any costs that may result from inefficient operations, poor administration, duplication of services, waste, negligence, and the like. If the organization is to attain its objectives, its different parts and members must function according to each other's needs and the needs and expectations of the total organization. In short, they must be well co-ordinated.

Attempts at improving the organization and operation of the hospital, especially the information system, have been hindered, according to Georgopoulous and Mann by the ". . . unavailability of sufficient knowledge from previous research regarding the common and unique characteristics of hospitals." The information system and its effects and interactions with the physical departments of the hospital is not well understood. Texts on hospital organization stress the organizational structure of the hospital at the expense of the more basic information system. Recent projects attempting to automate portions of the information system have frequently not considered the entire system, and while yielding useful results for the immediate hospital have provided little basis upon which others might base similar projects.

Research Objectives

This study attempts to make a contribution to the understanding of the hospital's information system. By investigating the structure and operation of the hospital's decision and information system facts will emerge that will be useful not only to the general understanding of the system but also to the design of a mechanized hospital information system. More specifically, through a systematic study of the activities within the hospital and the interactions between these activities, the research establishes a characterization or definition of the information and decision system. The form of this characterization will point out basic subsystems within the total hospital system and describe their relations to each other and to the system as a whole.

In addition to the major objective of the study as described above, there is a secondary objective of considerable importance. The problem of integrating such advanced applications as optimizing techniques, research of the medical record, and patient monitoring into the basic information system is studied and a basic framework of a mechanized system providing this integration is developed. The general nature of the hardware required for the mechanization of the integrated system is proposed as a framework for further system development and design.

Definitions

Several terms are of such importance to this thesis that it will be useful to define them at this point. In some cases the definitions will be the standard meanings of the terms while in other cases the terms are used in a specific manner and will need clarification.

System

A system is an assembly of functions united by some form of regular interaction or inter-dependence. Stated in another way, a system is an assembly of interacting elements, assigned to carry out predetermined functions.

Subsystem

A subsystem is a subset of the total system as defined above. The subsystem may have its own objectives but they should be subsidiary and supportive to those of the total system. The hospital subsystem is further defined to be organized along functional boundaries of the hospital system. Functional areas such as the diagnostic or therapeutic services will be defined as subsystems of the hospital information system.

Integration

Integration is the co-ordination of activities in such a way that the objectives of the set of activities are more readily attained. The effects of one activity on another are considered in the design of that activity and a method of operation is never chosen which will work to the detriment of the remaining activities.

Information

Information is an assemblage of data or facts. These data may be utilized by the system in the decision-making process or in the routine carrying out of procedures. Information does not have to be useful, but ideally an automated system would contain only useful information in a usable form.

Decision Activity

A decision activity is the process of choosing a course of action from several alternatives, given certain input information and the subsequent outcome of each alternative. A decision activity is thus a decision in the normal sense of the word. The decision activity may usually be programmed or pre-defined when a given set of inputs always results in a specific output. Decision activities do exist in which the outcome may not be readily programmed, an example of which is the doctor's order. Other decisions may only be made in an optimal manner after utilizing some mathematical decision-making technique, but these decisions will also be considered programmable.

Procedural Activity

The activities within an organization which do not have a choice of outcomes or alternatives are defined as procedural activities. These activities would include among others the tasks of filling out forms, ordering tests, transcribing results, or extending total dollar amounts, all of which are completely mechanical and have only one outcome. These activities would be completely programmable.

Activity

This thesis will combine the two activities above under the broad term "activity." For the most part, the term "activity" will be used throughout the thesis but the distinction between procedural activities and decision activities will remove any ambiguities arising when decision activities are discussed later in the thesis.

CHAPTER II

LITERATURE SURVEY

An examination of the objectives of the research suggests two general areas of literature which might be of use to the study.

Analysis and design of information systems

Mechanization of the hospital information system

The literature related to hospital organization provides a background for the research and provides a general acquaintance with the operation of the hospital. This literature, in general, however, stresses the departmental structure of the hospital with little emphasis on the underlying information system.

The literature resources of the IBM Corporation were at the disposal of the research and provided a great deal of background material as well as information pertinent to the study. These sources are not cited, unless quoted in the text, because of proprietary considerations.

Analysis and Design of Information Systems

The modern organization may be characterized as basically an information system. This information system performs the service of linking the various functions of the organization together by providing a flow of information throughout the organization. Norbert Weiner (16) argues this point and suggests that ". . . all organizations are

basically information systems and should thus be studied from that point of view."

The predominance of the elements of the information system in the organization is suggested by Figure 1 adapted from the Systems Development Corporation. The illustration points up the fact that the information system comprises the basic elements of the organization and in fact performs the function of co-ordinating the activities of the entire system.

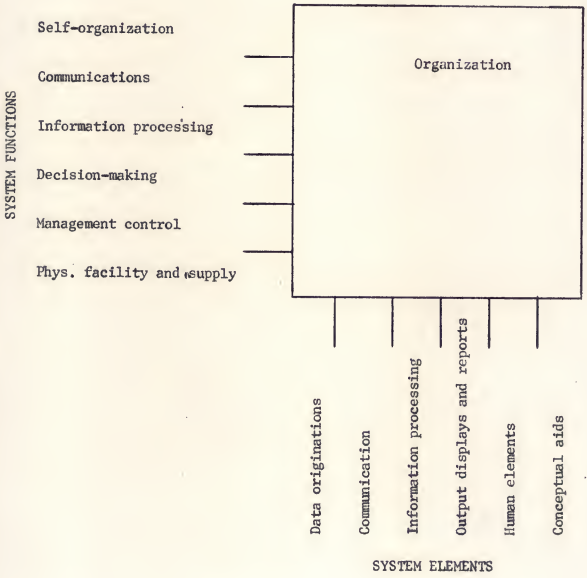

Figure 1. The elements and functions of an organization

The application of a computer in an organization is an automation of portions of the information system. The application of the powers of the computer to the information system requires an extensive understanding of the functions of the organization. Only after an adequate study of the requirements and limitations of the organization has been made, can the most efficient and worthwhile use of the computer be made.

Several techniques are available to aid in the analysis and design of information systems and while somewhat limited in power provide some help in characterizing the system. The most basic method of illustrating the operation of a system, excluding a narrative description, is that of flowcharting. Decisions and procedures are illustrated by blocks which are connected together with arrows showing the interconnection between functions. The technique is useful in gaining an understanding of the basic system but does not permit quantitative analysis of the operation of the information system.

Decision tables offer a means of quantifying the logic processes within the information system. Techniques such as TABSOL (11) reduce decision-making to a tabular form. The techniques are especially useful in the documentation of a complex decision process in which many factors must be considered and a multiplicity of outcomes is possible. The techniques are in general too cumbersome for handling the large number of simple decisions within an organization and especially the daily procedural activities which do not entail a decision process.

Brooks (4) has developed several techniques that quantify the information flow within a system and furthermore permit its study. Each decision and item of information in the organization is defined as an

element of the system. The elements are then placed in a matrix and manipulation of this matrix yields the structure of the entire information system, with the information necessary for each decision illustrated within the matrix. Redundant information is isolated so that only that information necessary to each decision need be included in the structure of the system.

Mechanization of the Hospital Information System

Progress toward implementing an automated hospital information system is being made at several large study projects about the country. A review of the developments will be useful as a framework for further study.

The Memorial Hospital of Long Beach (13) supported by a Public Health Service grant, is engaged in an extensive definition of the requirements of a hospital information system. Specifically, four basic subsystems are defined as comprising the system and are 1) The direct patient care subsystem, 2) The patient accounting subsystem, 3) The administrative and support subsystem, and 4) The research and education subsystem. The project develops a plan for further study and implementation of the hospital information system with emphasis on input-output terminals and techniques for studying the existing system and its requirements.

The consulting firm of Bolt, Beranek, and Newman, Inc. in conjunction with the Massachussets General Hospital in Boston (2) is presently designing and implementing a real-time hospital information system. The project is sponsored jointly by the Institute of General Medical Science of the National Institutes of Health and the American Hospital Association.

The goals of the project as stated in the most recent progress report are:

a. to utilize a time-shared computer with remote input-output devices to increase the rapidity and accuracy of collecting, recording, transmitting, retrieving, and summarizing information;

b. to decrease the amount of routine paper work required of the nursing staff;

c. to arrange and consolidate information for effective utilization of the medical staff; and

d. to develop a system that will store large amounts of complex medical information and will also permit rapid and easy search and retrieval of the stored information to facilitate clinical research.

The general approach utilized by the study team is that of attempting to solve the problem of user communication with the machine. Remote terminals are used in a question and answer mode with the machine able to prompt the user if any format questions arise. A significant logic system and language have been developed for use in interrogating the machine for purposes of research. Development work has progressed into four specific areas of the hospital defined as 1) The medication cycle, 2) The laboratory cycle, 3) The admission cycle, and 4) The research cycle. Five remote terminals are being used on a pilot basis for the development of the user programs in the four areas cited and for user education. Unfortunately for the current research, the study team's publications have been preoccupied with hardware and language considerations. Very little information concerned with the basic design concepts of the system has been published nor have plans been illustrated for the integration of other functional areas of the hospital into the system.

The Children's Hospital of Akron (5) with the aid of the IBM

Corporation has evolved a real-time system that performs many of the functions of the hospital information system. The study has provided a pioneering effort in the mechanization of the hospital system and is quite extensive, considering many of the complex interactions within the hospital system. A principle feature of the system is the use of a keyboard which is used to enter numeric coded information into the system. This method of information entry presents an important limitation to the system for the user must manually determine the proper coding sequence for the desired input. The computer being used as the central control element has definite expansion limitations and the addition of applications to the system has been hindered. Though hindered by these limitations, the development work has provided many basic concepts and techniques for the mechanization of the hospital information system.

A direct extension of the Akron hospital information system is the project presently under way at the University of Texas Medical Branch in Galveston, Texas (9). The IBM Corporation working jointly with medical center personnel are developing the basis for a complete hospital information system. Although very little is published on the basic design work, the scope of the effort in including virtually every department of the general hospital implies an extensive original design. The purpose of the project is to provide a broad operating base which will perform many of the routine activities of the hospital while providing the capability for the expansion of the activities of the system. The system is being implemented using programmed keyboards as the principle remote input device. The keyboards are programmed in such a way that the pressing of one button may imply as much data as the programmer wishes.

The meaning of the button is written on a plastic keymat and an indexing system is utilized to allow many values for a given button merely by changing keymats. The entire system is designed to assure maximum efficiency for the complex problem of data input to the computer.

Significant applications of computing equipment to the activities of the hospital are being carried on elsewhere in the country. It is necessary that these developments as well as their relationship to the hospital information system be mentioned.

The Veteran's Administration is in the midst of a very large scale project developing a real-time information system which will provide communications between the various VA hospitals. Very little has been published on the specific nature of the system or of its progress.

Tulane University (17) at its bio-medical computing center is developing the techniques necessary for storing and retrieving clinical medical record data. A set of coded forms is used by the physician to enter data into the system. Once entered, the data may be searched and retrieved by the machine. This work represents the most effort to date in automating the medical record, and as such will be very important to the fulfillment of the concept of the total hospital information system.

Both the University of California at Los Angeles (15) and the University of Missouri (12) are developing techniques for the acquisition, storage, and retrieval of clinical laboratory data. This work is also basic to the full integration of all hospital activities into the automated information system.

Advances in the automation and integration of the dietary system are being made at both the University of Florida (6) and Tulane University (1). The work at the University of Florida is concerned with

developing a total dietary system that will control the management functions of the dietary department. Such a system would be one portion of the activities to be integrated into the hospital information system.

Summary of the mechanistic approaches

Clearly, the development projects cited above, while providing significant results in specific areas of the hospitals, have, in general, not approached the automation of the hospital information system from the over-all viewpoint. The studies have either been preoccupied with mechanization of the system or have not considered all functions of the modern hospital and as such have not provided an integrated system design upon which further work can be based.

Blumberg (3) notes this problem and cites the need for additional basic research:

> . . . different groups are at work on data processing for the medical records library, the accounting office, the diet kitchen, and the nursing unit.
>
> In my opinion, each of these separate departments will in time realize that they are only a small part of the total picture and their individual problems must be related to the over-all data needs of the hospital. I am particularly impressed with the fact that a data system does not follow the traditional boundaries of hospital departments. Characteristically, information recorded in one department is used by another. A study of data used throughout the hospital is necessary to obtain a proper perspective.
>
> . . . Any comprehensive plan for using electronic data processing should be based on an analysis of information required for the several functions of the hospital. In order to make improvements in record-keeping systems of hospitals, much more must be known about the present and potential uses of records.

CHAPTER III

APPROACH AND SCOPE OF THE STUDY

The introduction developed the objectives toward which this thesis is directed. The two major objectives are 1) to provide a characterization and definition of the hospital information and decision system and 2) to develop the framework for an integrated hospital information system.

The first objective is primarily an attempt to formalize the basic system and extend the basic knowledge of the hospital system. Secondly, this improved definition of the system might imply directions toward which the mechanization process should proceed, and thereby provide a framework for a logical mechanized system.

The second objective also illustrates a desire to provide the groundwork for an actual system design. By studying the system from an over-all viewpoint, it is felt that the integrated system thus developed will provide a strong base from which the detailed design might be completed.

A reiteration of the philosophy of the research is important at this point. The research is concerned with only the underlying information system of the hospital. The research will be such that the organinational structure of a given hospital will make the results no less meaningful. There exist requirements on activities and information that

are common to most general hospitals and it is the study of these requirements, without regard to the organizational structure of the hospital, that serves as the basis for the research.

Characterization and Definition of the Hospital Information and Decision System

The research utilizes a four step approach to realize this first objective.

Definition of the hospital goals and environment.

Isolation of the basic activity and information requirements of the system.

Classification of the activities and information.

Definition and study of the hospital subsystems.

Definition of the hospital goals and environment

The first step provides a general framework in which the entire study is to be made. The over-all goals of the hospital must be kept in mind when attempting to explain the system or when developing a mechanization scheme. Similarly, the environment of the hospital must be clearly understood to yield insight into the operation of the system. Requirements placed upon the system from external sources as well as limitations imposed within the system must be considered during the system design phase of the study. Discussion pertinent to this first step was placed primarily in the introduction and literature survey chapters of the thesis. Continued study of the activities within the hospital add a great deal to this basic knowledge.

Isolation of the basic activity and information requirements of the system

The second step, that of isolating the activity and information requirements of the system, provides the basic knowledge of the system. This step in the research was chosen only after studying several philosophical questions pertaining to system design and analysis.

There are several variant philosophies concerned with system analysis and the subject is in fact very important to engineers in general and industrial engineers in particular. The approaches to system design vary from the technique of analyzing an organization on a departmental basis to that of analyzing the organization on a functional basis, without regard to departmental boundaries.

The first methodology is perhaps the more straightforward and at times the easier approach, in that individual departments may be analyzed and subsequently mechanized without regard to the remainder of the organization.

The very nature of this approach, however, is its greatest disadvantage, for there is a tendency toward sub-optimization using this technique. The problem arises when individual departments improve their operation without regard to the organization about them. There is a possibility of making the entire organization less efficient as a result of the attempts of an individual department to improve its own efficiency. Thus the operation of the larger organization is sub-optimized because of attempts at optimizing the operation of the individual departments.

With sufficient analysis, it is acceptable to study the organization from the departmental point of view. If it can be shown that optimization of one department does not create procedures that adversely

affect the operation of other departments, the organization can be analyzed and new procedures developed on a departmental basis. The interaction between the departments of a modern hospital is sufficiently complex to make this technique difficult. Few activities exist which do not affect several departments and an analysis of interaction would be comparable in scope to the developmental effort.

The approach of analyzing the hospital organization and operation on a functional basis, with little regard to departmental divisions, was chosen primarily to overcome any tendency toward sub-optimization. The exploratory nature of the research and especially the great deal of co-operation experienced in the hospital made this approach to the problem feasible.

In further applying the theory of analysis it becomes necessary to choose a technique for analyzing the basic operation of the system. Hall (8) suggests breaking the operation of an organization into its basic activities. After determining all of the inputs and outputs originating both internally and externally to the system, all of the activities within the system may be isolated. Each activity will act upon information that serves as input and will generate other information that serves as output. Pictorially, the relationship would consist of Figure 2.

The isolation of the activities basic to the system will thus be concurrent with the isolation of the information requirements of the system. The present set of activities and information will then be available for further characterization and definition of the hospital information system. This set of activities suggests the hospital's requirements on the information system and the design of an automated

information system must consider these requirements. Alternative activities may be developed, however, to satisfy the system requirements while taking advantage of the hardware configuration used by the mechanized system.

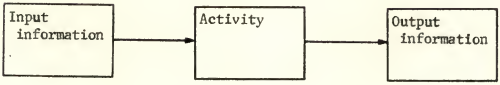

Figure 2. The activity-information relationship

Classification of the activities and information

In order to provide further insight into the operation of the hospital, a set of classification schemes is developed that would add meaning to the list of activities and information. These schemes are used to illustrate relations between activities within the system and between sets of information within the system.

A very important area of the classification of information is to its relative redundancy and pertinence to a given decision. The question as to whether a certain item of information is really required at a given point in the system should be asked of each item of information associated with each activity in the organization. Practical limitations of mechanization make this classification especially important.

The random nature of activities as well as the frequency of each activity is important to the specification of hardware requirements for the entire system.

The degree to which an activity is common to several functional areas of the hospital will be of use in simplifying the design by allowing a uniform set of activities to be used throughout the system.

Other schemes for classifying both information and activities will provide implications toward system design as well as provide a clearer definition of the hospital system. These classifications will be developed in Chapter IV.

Definition and study of the hospital subsystems

The final step toward a characterization and definition of the hospital system consolidates the facts and implications of the previous

work. At this point the logical information structure of the hospital is illustrated, showing the functional grouping of activities and the degree to which different departments interact. The set of activities is grouped into functional sets referred to as subsystems. Each subsystem illustrates a functional activity of the hospital and is not constrained by the organizational structure of the hospital. Additional study shows the relations between the subsystems and between the subsystems and the present organization.

Integration of the Hospital Information System

The term integration is sometimes used synonymously with mechanization of automation. A given system can be automated without the benefit of an extensive system design. The current procedures can be applied to the machine and the information system merely 'speeded up'.

This research is directed toward a study of the operation of the total system and as such uses the term integration to imply a coordination of all of the activity of the hospital into a single homogeneous information system. Within the confines of such a system, individual activities would be carried out in a manner augmenting the remainder of the system, aiding the entire system in reaching the objectives of the hospital.

The research utilizes a three step approach in the basic development of an integrated hospital information and decision system.

Definition of the goals of the integrated system

Integration of decision-making techniques into the basic activity framework

Development of a mechanization framework for the integrated system

Definition of the goals of the integrated system

The goals of the integrated system must necessarily be consistent with the goals of the hospital. The capability of the system to realize these objectives should be enhanced by the very nature of the integrated system. The reasons for expecting an improvement of patient care while maintaining or even improving cost performance will be explored.

Integration of decision-making techniques into the basic activity framework

The full integration of the hospital information system is not complete without the inclusion of the many techniques for optimal decision-making. The problem of scheduling the patient, doctor, and hospital personnel, as well as plant and equipment is illustrated as a single activity in the basic subsystem. The decision is usually made manually, with very few of the constraints of the situation taken into account in any explicit manner. The use of optimization techniques on decisions such as scheduling promises to decrease hospital costs through more efficient use of the resources of the hospital. The decision-making techniques and their application to the hospital will be discussed.

Similarly, the use of information retrieval techniques applied to the problems of data acquisition and medical research will be considered. Recent projects in these areas indicate the great deal of interest and possible reward in developing the techniques of information retrieval.

Development of a mechanization framework for the integrated system

The integrated system will finally be used as a framework for the

design of an automated system. A logical hardware configuration is developed which has the capability of controlling the information system. The problems of data storage and retrieval as well as those of the input and output to the system will be considered at this point.

Scope of the Study

In order to place the current work in the proper perspective it is necessary to discuss the scope of the study. The directions and possibilities for further research and development are many, as will be pointed out in the last chapter. In general, this thesis is of an exploratory nature, and as such serves as a framework for further development, both in the characterization and detailed system design of the hospital information and decision system.

Extent of system definition

The system definition and characterization is carried to the level of defining the subsystems of the total hospital system and the activities comprising each subsystem. The entire set of activities within the hospital is isolated and provided for further study along with the classifications of each activity and the information required for each activity.

Extent of system design

A basic framework around which a detailed system might be designed has been developed. Advanced decision-making techniques are integrated into the basic activity structure and the hardware necessary to implement the system is considered in general terms.

Economic analysis

A study of the economic feasibility of an automated hospital information system can not be included since the hardware configuration for such a system has not been specified in detail. Increasing costs in the hospital combined with the favorable experience of industry with advanced decision-making techniques suggest that the automated information system will be economically justified. Hospitals in general are just beginning to make wide use of the computer for business applications and use of the powers of the machine will soon be wide-spread in other areas of the hospital.

Technical decisions

Certain decisions are of such a technical nature as to be considered beyond the scope of this study. The many doctor's orders are decisions based not only on data made available by the information system but on factors such as experience and unrecorded observations. Only when the complete process of diagnosis is understood and quantified can these decisions be incorporated into the formal hospital information system. Other decisions of a similar nature arise in the dietary department in the planning of menus. Fortunately, a great deal of interest and work is producing results which suggest that these decisions will be possible within a mechanized system in the future.

Informal information system

A significant portion of any information system is the informal communication functions. The informal system makes use of memorandum records (semi-official documents relaying requests, directives, or

other communication between personnel, including unofficial versions of official records) telephone communication, and face-to-face communication to expedite much of the work undertaken by the system. Portions of the informal system would still be maintained in a mechanized system, but many of those activities normally found as part of the informal data system will in fact be eliminated with the use of the automated system. Many of these activities formerly required to resolve problems arising from a shortage of information will not be required by the integrated system.

CHAPTER IV

CHARACTERIZATION AND DEFINITION OF THE HOSPITAL INFORMATION SYSTEM

The characterization and definition of the hospital information system comprises the major portion of the task of this thesis. The objective in this case is two-fold, that of providing a formal insight into the data and decision structure of the general hospital and that of providing a framework from which a logical mechanized structure of the system can be developed.

The Activity and Informational Requirements of the Hospital Information System

The task of developing a definition of the hospital information and decision system begins with the understanding of the hospital's basic operation. The major portion of the "data gathering" of the research was undertaken to develop this understanding of the hospital's procedures and daily operations.

Before approaching all the departments of the hospital, a pilot study was undertaken in two of the departments, the clinical laboratories and the fourth floor medical patient unit. The pilot study gave the experience needed for conducting interviews in other departments and also formed the basis for the classification schemes to be discussed below.

The survey was extended to all departments of the Shands Teaching

Hospital of the J. Hillis Miller Health Center and considerable time was spent interviewing department heads and other personnel as well as observing the operation of each department.

The result of this phase of the research was a set of flowcharts depicting the activities, both procedural and decision, of the hospital. The flowcharts were used as a guide to compile a listing of the activities within the hospital. This listing includes the information required to carry out each activity as well as classifications for each activity and information item. The set of information was derived primarily from forms used in the hospital and the remainder from the discussions with hospital personnel.

The set of activities is included in Appendix III as a reference for the remainder of the thesis. Figure 3 illustrates the format of Appendix III. The activities are listed in serial order by their identification code. Thus, activity 984 is "Requisition Stores." The information required to be able to requisition stock is listed immediately below the activity. It will be noted that each item of information has been coded in the same manner as were the activities. Appendix II contains a cross-reference of these codes. A departmental code is included with each activity merely to facilitate a listing of activities by department if such a listing is desirable. Appendix I gives the cross-reference of these department codes to the departments studied in this research.

Associated with each activity and each information item in Appendix III and illustrated in Figure 3 is a classification number comprised of five separate classifications. These classifications appear in the same order as they are described in Table 2 and Table 3 and will be discussed in the next section of the chapter.

Activity Code/ Information Code	Activity/ Information	Department Code	Activity Class/ Information Class
984	Requisition Stores	99	22002
001	Item description		20103
025	Stock number		00000
008	Quantity		01000
007	Unit size		01100
013	Department account number		00000
979	Initiate Purchase	99	21002
---	---		
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Figure 3. Example of activity listing

In addition to defining the set of information required by the activities within the hospital, it will be useful to the remainder of the thesis to identify some of the subsets of the total set of information. These subsets of information as listed in Table 1 may be conceived of as data sinks or files which are used by the system to store data for later use. The activities of the system will be shown to utilize these files as inputs and again as outputs when the activity is completed. As a convenience to the illustration of the system later in the chapter, these files, rather than individual items of information, are depicted as inputs to activities.

TABLE 1

DATA SUBSETS

File Code	File Name
501	Medical record
502	Patient bill
503	Patient schedule
504	Department schedule
505	Department expense
506	Department revenue
507	Department statistics
508	Inventory records
509	Personnel records

It must be stressed that the set of activities isolated to this point are perfectly general in that they do not reflect how an activity is performed, the form of the information, or the organization of the stored information. The only concern to this point is the fact that a given activity is carried out and that the required information is available to the activity.

Classification of Activities and Information

A classification of the activities and information making up the hospital information and decision system will be useful in further characterization of the basic structure of the system. Classification schemes have been developed that will illustrate some of the basic relations within the system, providing a more rigorous definition of the system. The classification schemes will also provide a certain degree of insight into the problem of developing a mechanized framework for the integrated system.

The classifications are discussed in two sections below, corresponding to the classification of activities and of information. The classification codes associated with each activity and each item of information are included in Appendix III. Implications of the classifications will be considered at the end of the section.

The classification of activities

TABLE 2

ACTIVITY CLASSIFICATIONS

Classification	Code	Elements
Type of activity	0	Patient finance
	1	Patient care
	2	Hospital operation
	3	Teaching or research
	4	Other
Documentation	0	Primary
	1	Secondary
	2	No documentation
Relation to hospital field	0	General
	1	Unique to teaching hospital
	2	Unique to J. Hillis Miller
	3	Absent at J. Hillis Miller
Temporal nature	0	Random
	1	Periodic
Frequency of activity	0	Less than hourly
	1	Hourly
	2	Shift or daily
	3	Weekly
	4	Monthly
	5	Greater than monthly

Type of activity.--The classification of activities by type suggests a natural grouping of the activities within the hospital. Most of the activities will be classed within the first three elements.

Patient finance--The activity affects the financial status of the patient. Activities such as "charge patient" or "generate final bill" would be included within this classification.

Patient care--The activity directly affects patient care, whether

diagnostic or therapeutic in nature. This class would include such activities as "report results" and "schedule patient."

Hospital operation--This class takes into account hospital activities, including among others; financial activities, personnel, maintenance, and indirect patient care such as ordering from sterile supply. The activities of updating the department schedule and updating the departmental revenue would be included under this classification.

Teaching and research--This class is concerned with those activities made only for teaching purposes. Scheduling the patient for classroom observation is one example of this class.

Other--The activity is not included under one of the other classifications.

Documentation.--The set of activity classes pertaining to documentation refer to the nature of the record that is initiated or updated as a result of the activity. Certain activities affect records of a permanent nature while others generate records of a temporary nature.

Primary--The activity updates or initiates some record used in primary or first line documentation. The record is essential to patient care or hospital operation from a financial, moral, or legal standpoint. Examples of primary records would be the medical record or the patient bill.

Secondary--The activity results in a record useful only as back-up to a primary record and is usually in the form of a memorandum record. The secondary record might be retained for convenience

or back-up but the original data is always available in some primary record. Examples of this class of activity would be the updating of the medication file at the nurse's station or updating a name-hospital number cross-reference file used for the convenience of the individual department.

No documentation--The activity updates no record. Any document that may be generated is of a temporary nature only and will be destroyed when its immediate use is completed. Other activities may be undertaken based on this activity but there is no formal document linking the two activities. A request for additional information from one department to another is an example of this class of activity.

Relation to the hospital field.--This classification suggests the degree of generality of each of the activities of the hospital. The classification is necessarily based on judgement and as such will only provide an estimation of the degree of generality present in the system depicted in this thesis.

General--The activity is thought to be general throughout the hospital field. It is of such a basic nature to patient care or to common business practices that there is very little question as to its generality. Examples of this class would be the functions of ordering medication or of charging the patient.

Unique to teaching hospitals--The activity is required to aid in the teaching process and would probably not be found in the general hospital.

Unique to J. Hillis Miller--The activity is sufficiently unique to the J. Hillis Miller Health Center to exclude its entry into the general classifications of activities. Activities required only by the State of Florida would be included in this class.

Absent at J. Hillis Miller--The activity is not a part of the operation of the J. Hillis Miller Health Center. The use of the activity is considered important enough to warrant its use in the general hospital.

Temporal nature of activity.--This classification indicates whether the activity occurs on a periodic or random basis.

Random--The activity occurs at random points in time. Activities which depend on the completion of a previous random activity will also be classed as random even though they might be batched for periodic processing. An example of a random activity is that of updating the patient bill. While this activity might be periodic in a given hospital, the actual charges to the patient occur at random.

Periodic--The activity occurs in a periodic, usually predetermined schedule. This periodicity is usually caused by the periodicity of some activity external to the system and not under the control of the system. Thus, in a State institution, the payroll will be processed monthly because the checks will only be sent from the State on a monthly basis.

Frequency of Activity.--An activity is classed under this scheme by its relative frequency of occurrence. The frequency applies to the hospital as a whole rather than to individual departments.

Less than hourly

Hourly

Shift or daily

Weekly

Monthly

Greater than monthly

The classification of information

The information required for each activity may also be classified, but there is an important difference between the classification schemes for activities and those for information. The classification of an activity remains constant no matter where or when the activity is undertaken. Information, on the other hand, will assume different meanings according to the different ways in which it is used. A given item of information will not have a standard classification but its classification will provide a description of its use relative to the activity with which it is currently associated. The following definitions and discussion will make this point clear.

TABLE 3

INFORMATION CLASSIFICATIONS

Classification	Code	Elements
Symbolic nature of information	0	Numeric
	1	Codible
	2	Not codible
Type of information	0	Identification
	1	Quantitative
	2	Existence
Origination of information	0	Prime
	1	Derived or computed
Mode of use of information	0	Normal
	1	Used as existence data
Significance relative to activity	0	Available and used
	1	Unavailable and useful
	2	Available for future use
	3	Available for control

Symbolic nature of information.--The symbolic nature of data refers to that property of data allowing it to be encoded for use by computing machinery. This classification will remain constant although the information item is used with different activities.

Numeric--The information is purely numeric. It may be entered into a machine as it stands, with no coding necessary. Obvious examples of numeric information are dollar amounts, the number of pints of blood required for a patient, or the number of vacation days accumulated by an employee.

Codible--The information is readily codible and may be either

non-numeric or numeric. The data represents facts, events, or even quantities that may be expressed by some pre-established code structure. Examples of codible data are coded laboratory tests or the different floor or wing numbers. It should be noted that in the case where data might be classed either numeric or codible, the codible class will take precedence.

Not codible--The information is of a nature to make its encoding difficult. This type of data is usually narrative information and could be stored within the machine in its narrative form. Continued development of common sets of language in the medical diagnosis and symptom fields may soon make possible the encoding of much of this information. Nurse work plans as well as discharge diagnoses are examples of data usually not codible.

Type of information.--Brooks (4) proposes the existence of three types of data which are classified according to the "essential nature of the data, rather than its source or intended usage." This classification again remains constant no matter how the information is used.

Identification data--This type of information identifies people, objects, occurrences, or quantities, among other things. Examples of identification data are personnel numbers, stock numbers, and dates.

Quantitative data--The information is quantitative and is the result of some measurement, count, or computation. Such data as the reorder level of stock or the number of beds on a wing are examples of quantitative data.

Existence data--The information is of a logical nature. It expresses the fact that some event has occurred. The absence of the data necessarily implies the event has not occurred. The fact that a patient has been discharged indicates that a final bill will be required for that patient.

Origination of information.--This classification gives an indication of the original entry of each item of information into the system. A given item of information might be originated by one activity and used by another activity, requiring a change of classification with the change of activity.

Prime--The data has been entered into the system or been generated by an occurrence within the system. Examples of prime data are the entry of the monthly income of the patient into the admitting financial record or the generation of the physician's report from surgical pathology.

Derived or computed--The data has either been computed or derived from prime or other derived data in the system. Information that is used many times by the system, even though it may be in the same form as when it entered the system, will be classified as derived data. The patient number will be prime data when first assigned to a patient but will be derived data in all activities subsequent to the origination.

Mode of use of information.--This classification indicates the use of data in the context of the activity with which it is associated.

An item of data, while being identification or quantitative data, might be used as existence data by some activity.

Normal--The information is used in the way implied by the 'type' classification. that is, identification, quantitative, or existence.

Used as existence data--Identification or quantitative data is used as existence data. An event's occurrence is inferred from the existence of some data. This use of data is illustrated when the appearance of a patient identification on the nightly census is used as the fact initiating a room charge against that patient.

Significance relative to activity.--The significance of data relative to the activity it is associated with is very important. In some cases information might be available and not used while in others it is not available and would be useful. Information is often carried along on a form for control such as additional identification information. The extent to which this is the case will be shown to be important to a mechanized system.

Available and used--The information is available to the activity and is utilized in carrying out that activity.

Unavailable and useful--The information is not available to the activity and would be useful if present. This information might be required for the efficient operation of a mechanical system while not critical to a manual system. An extra code number might be used to simplify operations internal to the system while remaining of no use to the system outside the machine.

Available for future use--The information is available for future use in advanced applications. Statistical data might be too burdensome within the confines of a manual system while it might be of more use to the mechanized system because of the increased processing capability of the machine.

Available for control--The information is available as backup or control of the basic information necessary to an activity. The information is often redundant and would be considered for elimination from a mechanized system. On most correspondence between departments, additional patient identification is included for positive control. In cases in which the information is processed by the machine, all of this information would not be required and could be eliminated from the flow of data.

Implications of the classifications

The classification of the activities and information within the hospital system aids in characterizing and defining the hospital information and decision system. The results of several of the classification schemes provide implications toward the automation of the information system.

It should be pointed out that the judgement of the author was required in placing the activities under the various classifications.

The percentage figures for each classification were obtained by running the data cards (activity cards) through a tabulating sorter.

Type of activity.--Classification of activities by type showed that activities fall within three distinct groups. The percentage

figures in Table 4 suggest the obvious importance of patient care and hospital operation.

TABLE 4

TYPE OF ACTIVITY

Patient finance	11%
Patient care	46%
Hospital operation	43%
Teaching or research	0%[a]
Other	0%

[a]There were no activities classified as unique to a teaching hospital. While a certain amount of work is necessitated because of the teaching environment, this work represented increases in volume of normal activities. The teaching function as such was not included in the activities.

Documentation.--A study of the activities of the hospital from the standpoint of the records they produce is facilitated by the use of the classification on documentation. This classification shows that many of the activities in the hospital are not updating or affecting one of the primary records. Many of the activities exist due to the lack of confidence in the accuracy of the primary record or sometimes exist to improve the accessibility of certain information. The activity exists because of a genuine desire to provide safe and speedy recovery of the patient and if the proper information is not readily available the information system is at fault. The information system must be designed in such a way that the data is available upon request, assuring efficient operation of each department and the availability of information in an emergency. Specific percentages of each activity in this classification are given in Table 5.

TABLE 5

DOCUMENTATION OF ACTIVITY

Primary documentation	61%
Secondary documentation	33%
No documentation	6%

Relation to the hospital field.--The results of this classification as illustrated in Table 6, show that most of the activities as defined in Appendix III would be general to the typical short-term hospital. This is to be expected because of the basic nature of the activities. All hospitals will require certain functions and while each hospital may carry out an activity in a different manner, the basic function is present.

TABLE 6

RELATION OF ACTIVITY TO HOSPITAL FIELD

General	97%
Unique to teaching hospital	0%[a]
Unique to J. Hillis Miller	2%
Absent at J. Hillis Miller	1%

[a]See footnote on Table 4.

Temporal nature of activities.--This scheme of classification showed that all but a few activities of the hospital are essentially random in nature and not periodic. Although certain activities are forced into some cycle because of an external influence or for the convenience of the present system, the majority of the transactions in the hospital are

at random as suggested by Table 7. An automated information system would most likely provide the capability of capturing information and updating files on this same random basis. Only in this way would the information system be up-to-date and be capable of providing the necessary functions to the hospital.

There exists a set of activities which has assumed a periodic nature partially because of habit and partially because of technical considerations. This set of activities is typified by the issuance of medication on some hourly basis. The ordering of the medication was certainly at random, as was the processing of the order and the issuance of the drug to the floor. The drug is then held until the "proper" hour and the medication given. Under the control of an automated system the proper interval could be maintained by the system, but medication could be administered to different patients throughout the hour. Study of the feasibility of this method of drug dispensing would be worthwhile to show what efficiencies might be possible.

TABLE 7

TEMPORAL NATURE OF ACTIVITY

Random	93%
Periodic	7%

Frequency of activity.--The classification scheme showed that most of the patient care activities occurred frequently. The information system must be capable of handling a large volume of requests for service and reporting of results, and much consideration must be given to the hardware capable of meeting these demands of high frequency. The percentages of each element of this classification are given in Table 8.

An extension of this analysis will be required in the detailed design of an automated hospital information system. The frequency distribution of each activity in each area of the hospital should be determined to facilitate the choosing of input-output hardware and the design of programming techniques.

TABLE 8

FREQUENCY OF ACTIVITY

Less than hourly	56%
Hourly	16%
Shift or daily	21%
Weekly	4%
Monthly	2%
Greater than monthly	1%

Symbolic nature of information.--The degree to which an item of information is codible has obvious implications toward the mechanization of a system. Many functions are easily implemented on computing machines because of the codible nature of the data. Other applications, medical records being a major one, resist mechanization because of the great deal of narrative data they contain. The codibility of the information for a given activity gives an indication of the magnitude of the files required as well as an insight into the problems of input of the data into the system. The classification showed most of the data to be either numeric or codible. The remainder of the data must be used in its raw form or encoded with the use of extensive dictionaries. The specific breakdown of the classifications is given in Table 9.

TABLE 9

SYMBOLIC NATURE OF INFORMATION

Numeric	43%
Codible	40%
Not codible	17%

Type of information.--This classification of information aids in the understanding of the basic nature of the data in the system. The classification might also be used as a measure of the redundancy of information for a given activity. When more than one item of identification information identifying the same entity is associated with an activity, the set of information should be studied to find if the added reliability is really necessary. Redundancy essential to a manual system but not essential to a mechanized system should be removed for the sake of increased efficiency in the automated system. The three types of information were found to have the distribution shown in Table 10.

TABLE 10

TYPE OF INFORMATION

Identification	78%
Quantitative	21%
Existence	1%

Origination of information.--For the most part, data is originated or required at points in the system remote from any central location. This fact accounts for the requirement of remote input in an efficient mechanized system.

A second important implication of this classification is the observation that much information that appears to originate at some point in the system is actually a by-product of some other activity. A system can be made more efficient by utilizing as much by-product information as possible and thus eliminating the need for multiple generation of information. The order for medication should be used as an indication that the patient is to be billed as well as an indication that medication should be sent to the floor; otherwise the patient must be billed with a second input to the system and the total input involved will be approximately double what it might have been.

A third observation from the study of this classification is that many of the information items found in Appendix III are not prime but are derived or calculated. Further study shows that most of these items are in fact data which is being used a second, third, or tenth time in its original form. Many varied activities will use the same item of information throughout the daily operation of the hospital. The information system must be capable of supplying identical information to the various activities requiring it. The implication of these requirements is that a mechanized system would most likely utilize a large random-access storage device to hold the information in a manner making it available to any request. Data was found to originate according to the distribution in Table 11.

TABLE 11

ORIGINATION OF INFORMATION

Prime	54%
Derived or computed	46%

Mode of use of information.--The use of identification or quantitative data as existence data indicates a form of by-product usage of data. Existence data indicates that some activity should take place as a result of some other activity. If quantitative data can be utilized to give this indication of existence, an item of existence data will not have to be generated and a savings in data generation will result. The unfortunately small percentage of the time this efficiency takes place is shown by the distribution in Table 12.

TABLE 12

MODE OF USE OF INFORMATION

Normal	99.5%
Used as existence data	.5%

Significance relative to activity.--The classification of information as to its importance relative to a given activity can be an aid in studying the redundancy of data within a system. It will be important to eliminate redundant information from a mechanized system for its inclusion will make necessary larger storage and faster input-output hardware.

Other information which might not be of use to a manual system might be very useful to a mechanized system. Statistics of activity whthin the hospital can easily get out of hand in the manual system but can be included in the faster automated system for use in control of the system. The distribution of this classification scheme is given in Table 13.

TABLE 13

SIGNIFICANCE OF INFORMATION RELATIVE TO ACTIVITY

Available and used	94.3%
Unavailable and useful	.1%
Available for future use	.0%
Available for control	5.6%[a]

[a]The determinination that an item of information is required only for control and is not required by the activity is a value judgement that can be made only by one in intimate contact with the activity. The research has been conservative in this classification for this reason and it is presumed that the percentage figure for control (and redundant) information should be larger.

The Hospital Decision and Information System-The Functional Structure

The research to this point has studied the basic activities of the hospital system. These activities and the information required to carry out each were illustrated in such a way that they could be isolated from the departmental structure of the hospital. Certain classification schemes were then applied to the set of activities and to the set of information in an attempt to more fully understand and characterize the system. The classification schemes were developed to point out any logical relationships within the system and suggest implications toward a mechanized or integrated system.

The next goal of the research is the description of the decision and information system without the constraints of the organization. The definition should follow functional operations within the hospital. Such a definition will be useful in serving as a basis for the design of a mechanized system. The design so conceived would not have to be

forced to fit some predetermined organizational structure and would provide for more optimal operation of the hospital, without the problems of sub-optimization due to organizational restraints.

Hospital subsystems

The functions within the hospital may be defined as subsystems within the larger hospital system. These subsystems will be shown to cross present departmental boundaries. Thus, a given subsystem is not totally confined to a single department of the hospital. Indeed, it would be unusal if this were the case considering the complexity of the hospital system. Several of the subsystems will be shown to include the activities of many departments and others will be shown to be included in the activity of all departments. The subsystems defined in this study are listed in Table 14.

TABLE 14

HOSPITAL SUBSYSTEMS

Medication subsystem
Diagnostic subsystem
Therapeutic subsystem
Surgical subsystem
Dietary subsystem
Medical record subsystem
Admission and discharge subsystem
Billing subsystem
Administrative reporting subsystem
Inventory subsystem
Maintenance and housekeeping subsystem
Personnel subsystem

The subsystems of the hospital, in providing for the daily activities, require information for carrying out these activities. The classification showed that a small set of information is used by many

different activities. It will be shown later that the same information is also required by different subsystems of the hospital. This requirement for the same information throughout the hospital suggests the need for a central file servicing the different subsystems. In a properly designed system, this concept can be realized to its fullest advantage while a manual system must utilize multi-part forms and other techniques to provide the same information to divergent subsystems. Figure 4 illustrates the relations between the central files, the subsystems, and the total hospital information system, and suggests an interface of control between the stored data and the subsystems requiring the data. Within the confines of an automated system, the input and output comprising the communication between the information system and the remainder of the hospital system would be a function of each of the subsystems. Communication among subsystems and between each subsystem and storage would be controlled by a supervisory program which would yield control of the machine to specified subsystems requiring service.

The subsystems of the hospital system are now discussed in some detail. A flowchart of each subsystem is included with the activities serving as blocks. In addition a matrix representation is included for most subsystems which relates each activity to the other activities in the subsystem.

The matrix contains the activities of the subsystem along each axis. Entries are made in the matrix when an activity on the vertical axis immediately precedes an activity on the horizontal axis. Using Figures 5 and 6 as examples, it will be noted from the flow chart that activity 999 immediately precedes activity 709. Referring to the matrix,

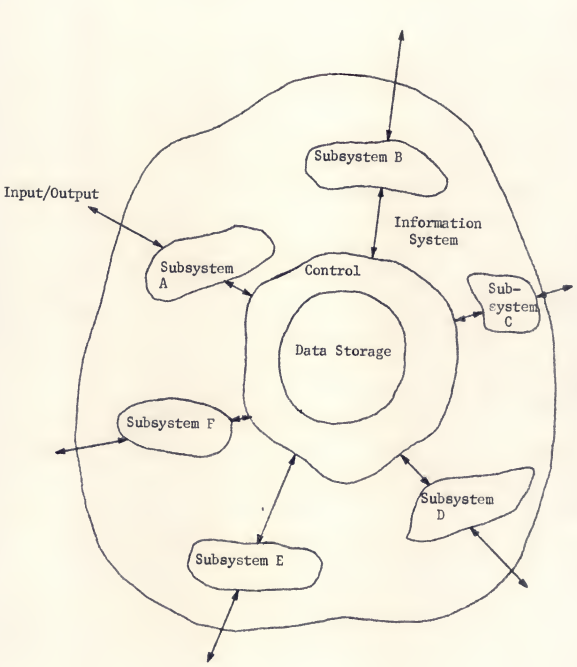

Figure 4. The hospital information system

this same relation is illustrated with an "X" at the intersection of 999 (vertical axis) and 709 (horizontal axis).

In some cases an activity will have neither an activity immediately preceding it nor an activity immediately following it. These activities will in some cases be a representation of a data sink as defined in Table 1 and in others will be an end point of that subsystem as defined by this research. The activity in this case may be an entry point in another subsystem. Thus, activity 983 (generate receipt-issue) is an output of the medication subsystem and an input of the inventory subsystem.

The medication subsystem.--The medication subsystem includes the activities of several major departments in the general hospital. The pharmacy, patient floor, inventory and purchasing, and patient billing each have a part in the medication subsystem. This subsystem is responsible for the ordering and dispensing of drugs, I V fluids, narcotics, and in broad terms, blood to the patient. The matrix representation of Figure 5 indicates the relations between the activities making up the subsystem. The flowchart of Figure 6 aids in illustrating the subsystem.

The diagnostic subsystem.--The diagnostic subsystem is a general subsystem which encompasses the activity of many of the departments of the hospital. The outpatient clinics, clinical laboratories, radiology, EEG, EKG, nuclear medicine, autopsy, and surgical pathology are a few of the many departments providing diagnostic functions to the hospital. While the departments carry on other activities, their primary tasks are diagnostic and the bulk of their activity volume is related to this function.

It may appear that the subsystem is overly generalized, but in fact the diagnostic subsystem is very general. The objectives and activities of each department are the same with only the specific tests performed being different among departments. As in the medication subsystem, the medical record provides an input and an output to the subsystem. The physician's technical decision is not classified, but does occur between the data input and the ordering of the diagnostic function. This decision was not included because of the difficulty of isolating the decision criteria and the complete set of input data. Figures 7 and 8 illustrate the diagnostic subsystem.

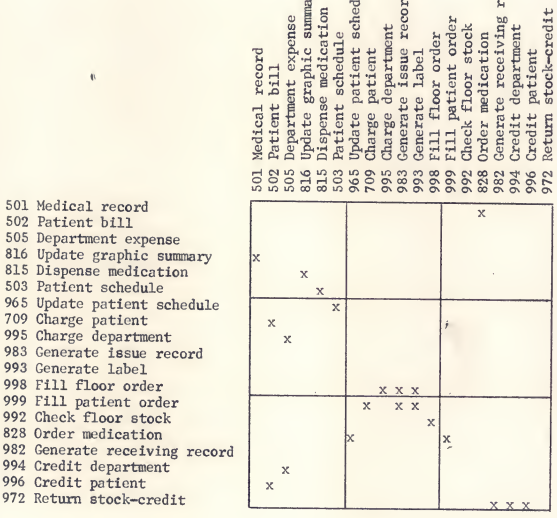

Figure 5. Medication subsystem matrix

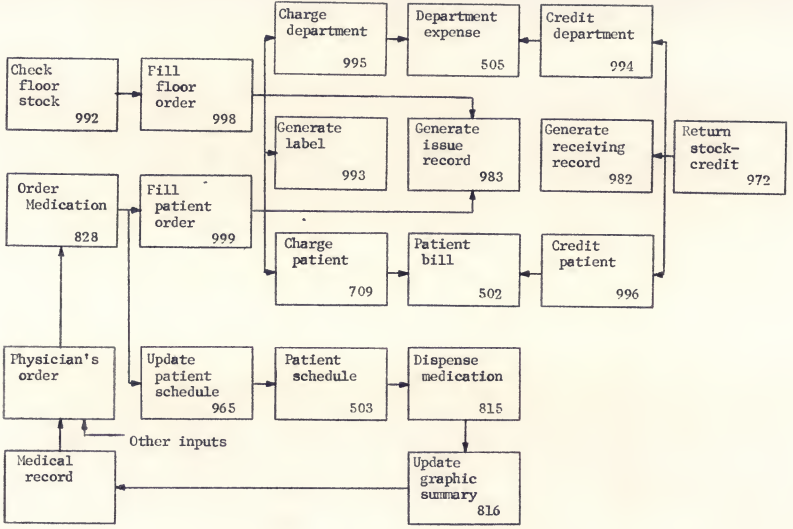

Figure 6. Medication subsystem flowchart

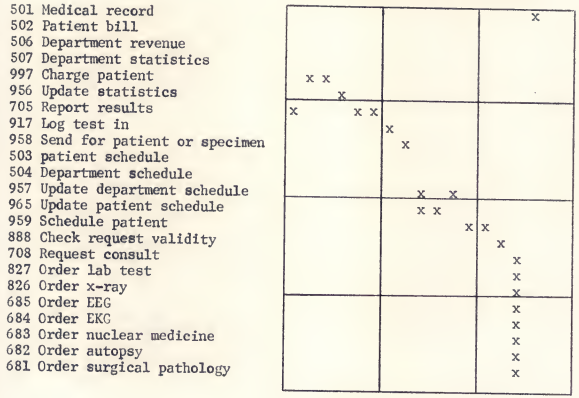

Figure 7. Diagnostic subsystem matrix

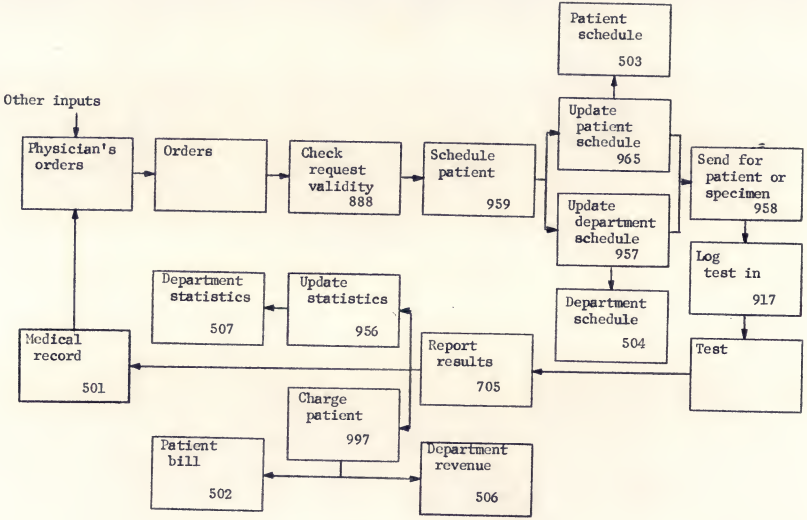

Figure 8. Diagnostic subsystem flowchart

The therapeutic subsystem.--The therapeutic subsystem is another general subsystem. The subsystem includes the major functions of the treatment departments and certain functions of the patient floor. Among departments included in this subsystem are rehabilitation, inhalation therapy, radio therapy, and the patient floor. Departments such as dietary and the pharmacy are also therapeutic in nature, but the major theme of ordering treatment, scheduling the treatment, reporting the results, and charging the patient is absent from these departments.

The surgical subsystem.--The surgical subsystem is common to most general, short-term hospitals. The subsystem furnishes the administrative system surrounding the operating suite of the hospital and while it is very similar to the therapeutic subsystem, certain activities are sufficiently different to warrant including it as a special subsystem. The activities included in the surgical subsystem are illustrated in Figures 11 and 12.

The dietary subsystem.--The dietary subsystem encompasses most of the operation of the dietary department of the general hospital. The current diets of each individual patient must be maintained and a menu designed that can accommodate the varied diets found in the hospital.

By continual accumulation of the statistics, the subsystem can modify the basic diets and menus used in the hospital. Cooking instructions may be prepared and stock ordered ahead based on these same statistics. Recent work in integrating this entire operation into a system capable of computing an optimal set of diets promises substantial cost reductions while maintaining the nutrient level to the patient.

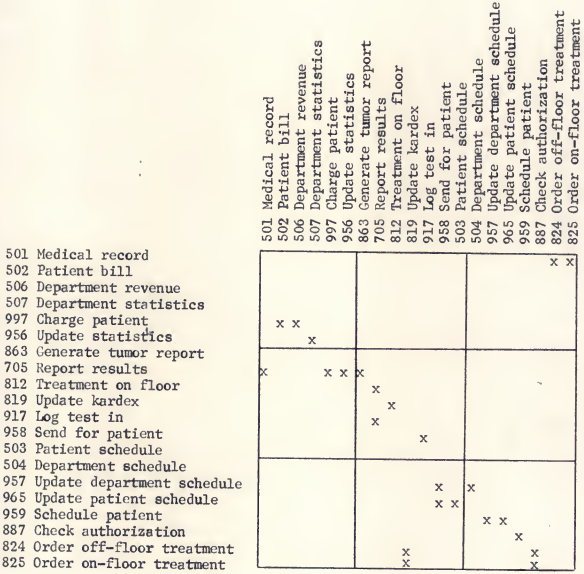

Figure 9. Therapeutic subsystem matrix

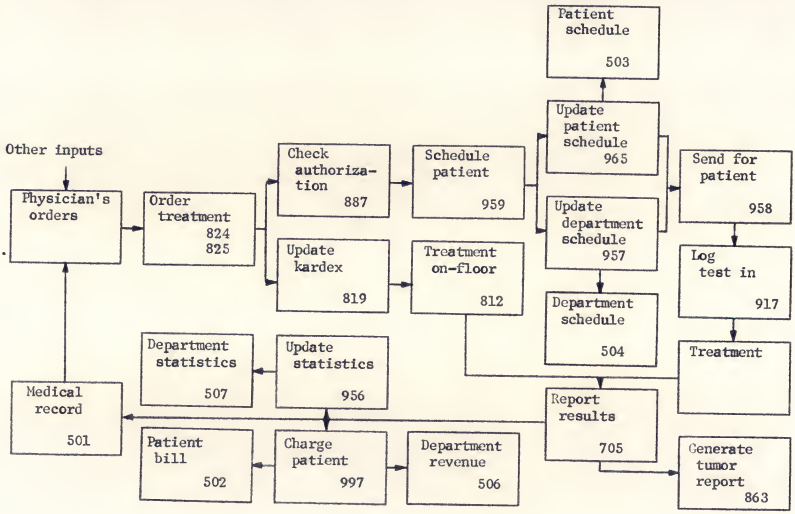

Figure 10. Therapeutic subsystem flowchart

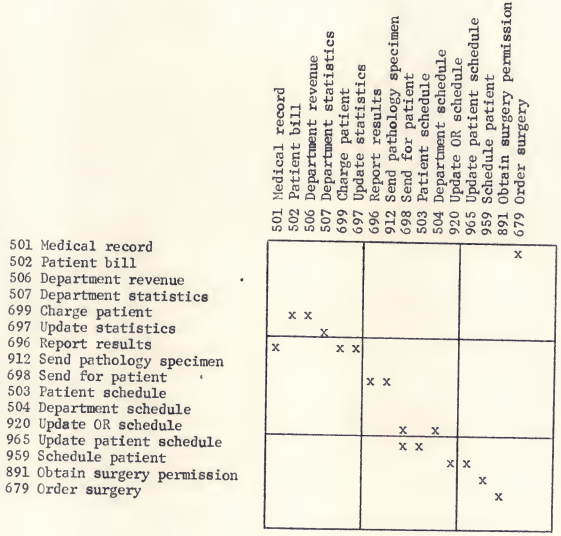

Figure 11. Surgical subsystem matrix

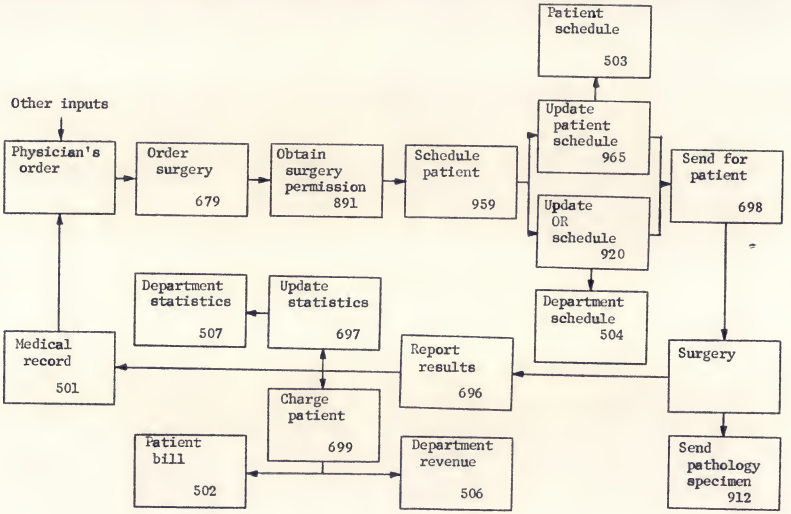

Figure 12. Surgical subsystem flowchart

It should be mentioned in passing that the typical hospital probably does not have a selective menu from which the patient can choose his own meal, but the trend indicates this may soon be the case. The general functions of the dietary subsystem are illustrated in Figures 13 and 14.

The medical record subsystem.--The medical record subsystem furnishes the function of maintaining the patients medical record for use by the remainder of the hospital system. Note that in the representation of the subsystem several of the activities are not numbered and are thus not included in Appendix III. These activities are implied activities only and are included as a conceptual aid in illustrating the subsystem.

The subsystem basically accepts requests for records or information within records, finds the record and displays the information to the authorized personnel. Maintenance of a cross-reference file equating names to hospital numbers is also a responsibility of the subsystem. Data is entered into the record from some of the sources suggested in the block diagram and upon discharge of the patient the record is checked for completion and deactivated. The medical record subsystem is described in Figure 15.

The admissions and discharge subsystem.--The admissions and discharge subsystem includes the activities of admitting the patient and those of discharging the patient. The admissions portion of the subsystem is primarily a data gathering activity for the benefit of the remainder of the hospital. Much of the data subsequently used by other subsystems of the hospital is initiated at this point in the system. Figures 16 and 17 illustrate the subsystem.

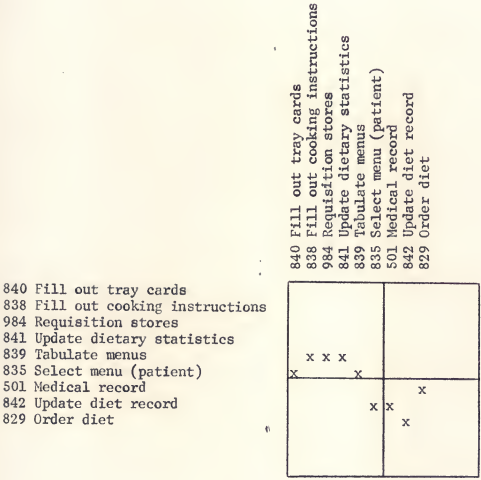

Figure 13. Dietary subsystem matrix

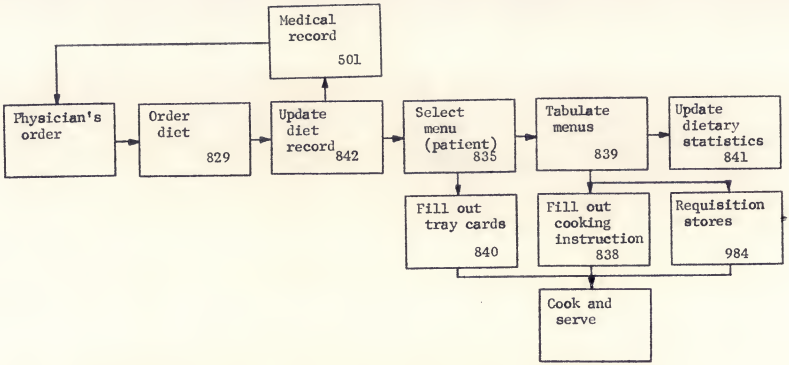

Figure 14. Dietary subsystem flowchart

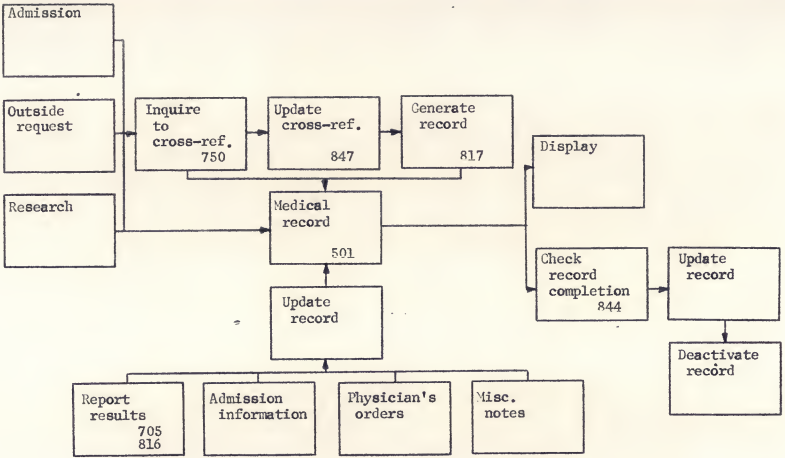

Figure 15. Medical record subsystem flowchart

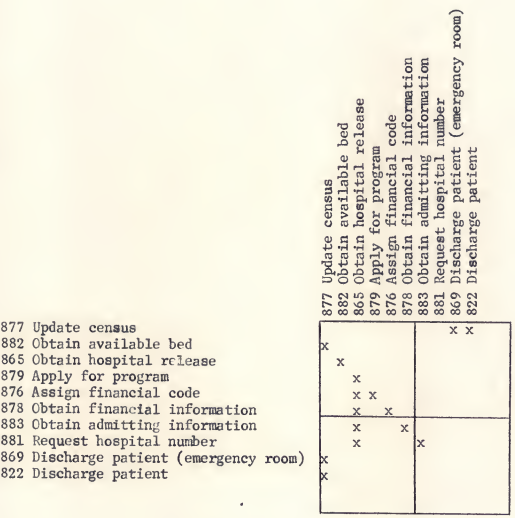

Figure 16. Admission and discharge subsystem matrix

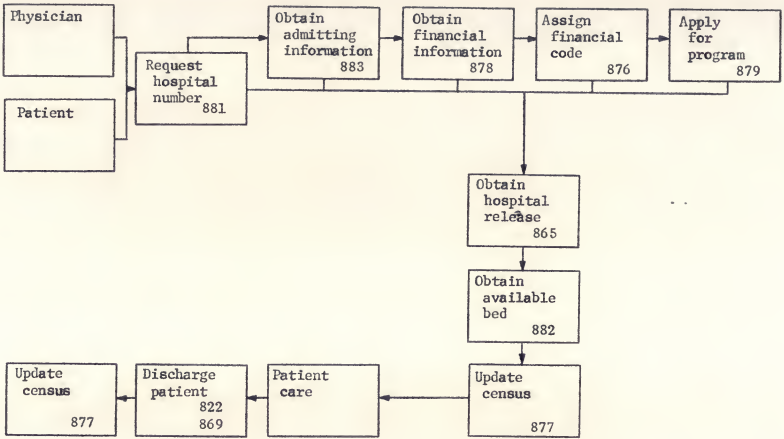

Figure 17. Admission and discharge subsystem flowchart

The billing subsystem.--The billing subsystem receives inputs in the form of patient charges from the other subsystems and produces outputs in the form of patient bills, department revenue statistics, and accounts receivable. The billing subsystem is described in Figures 18 and 19.

The administrative reporting subsystem.--The administrative reporting subsystem has the responsibility of accummulating the statistics of the operation of the hospital, condensing them into the proper form, and supplying them to the administration of the hospital.

These functions are presently primarily performed by the accounting department with the statistics of productivity coming from each individual department. Under the framework of a mechanized system, these outputs will all be accummulations of data as a by-product to the normal operation of the hospital. Figure 20 illustrates this subsystem.

The inventory subsystem.--All existing departments of the hospital utilize the services of the inventory subsystem. The ordering of new stock or the requisitioning of existing stock is accomplished through the inventory subsystem. The inventory of the hospital is maintained by this subsystem and advanced inventory control techniques would be integrated into the basic framework of activities as illustrated in Chapter V. The subsystem is described in Figures 21 and 22.

The maintenance and housekeeping subsystem.--The maintenance and housekeeping subsystem is very straight-forward with the primary responsibility of the subsystem that of upkeep of the hospital. Requests for service often come from a patient care facility and as such are

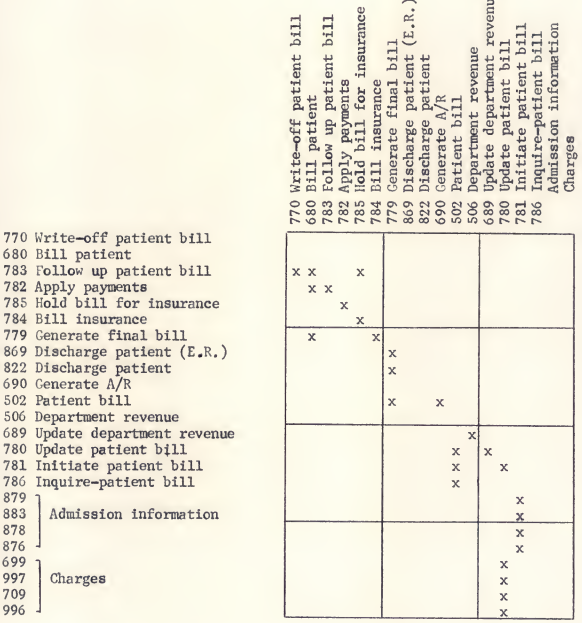

Figure 18. Billing subsystem matrix

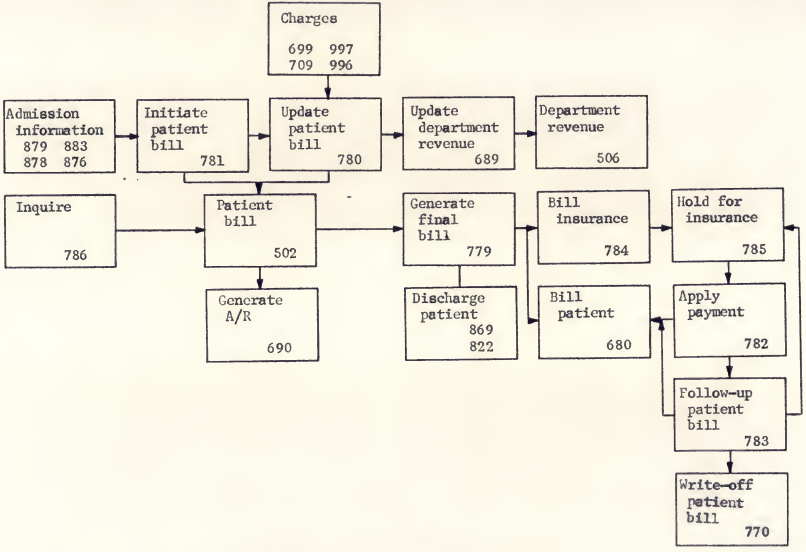

Figure 19. Billing subsystem flowchart

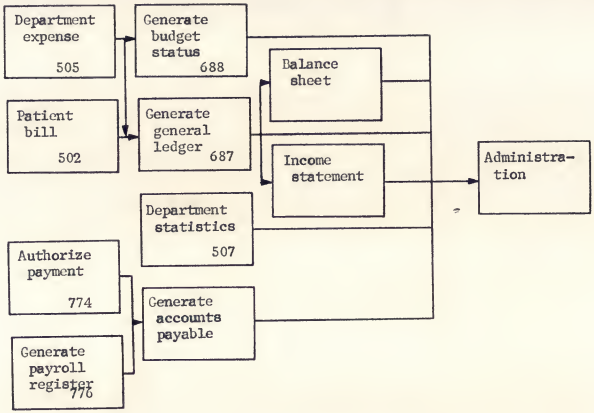

Figure 20. Administrative reporting subsystem flowchart

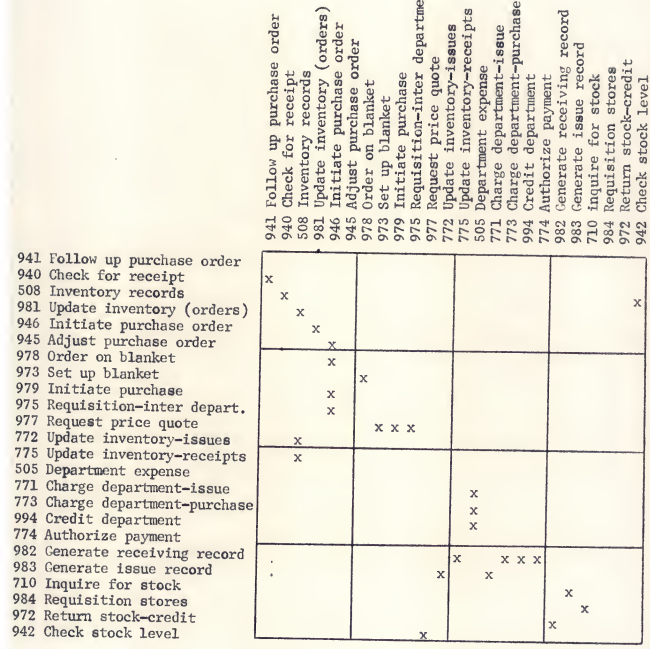

Figure 21. Inventory subsystem matrix

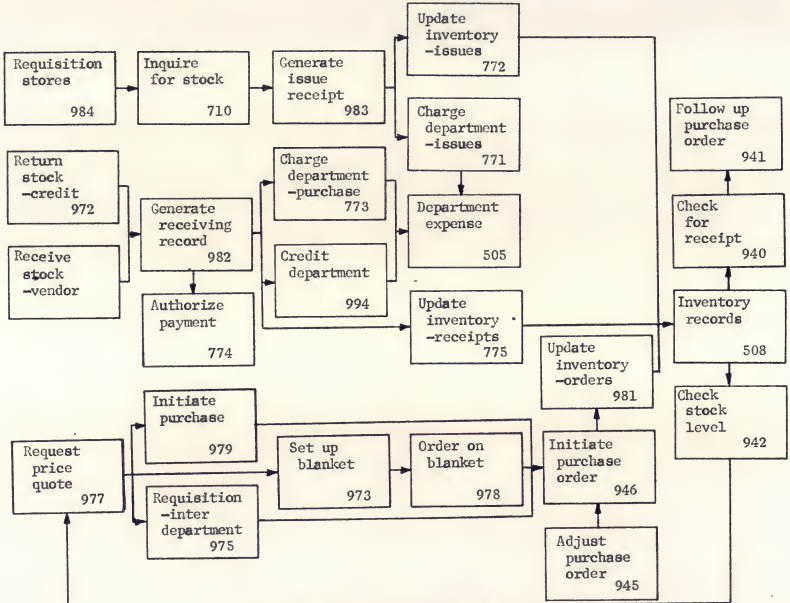

Figure 22. Inventory subsystem flowchart

directly related to an improvement of patient care. Figures 23 and 24 illustrate this subsystem.

The personnel subsystem.--The personnel subsystem is a part of each department of the hospital. Inputs to the subsystem are in the form of personnel requirements and reports of personnel time from the individual departments. The subsystem maintains the personnel records of all employees as well as an active file of applications for work. A major output of the subsystem is the payroll register which then serves as a master for the writing of payroll checks. The personnel subsystem is described in Figures 25 and 26.

Completeness of subsystems

Correlation of Appendix III and the subsystems defined above will show that most of the activities of the hospital are included in at least one of the subsystems. In a few cases, however, the activity seems to have been neglected. In almost every one of these cases the activity is included if the operation of the system is viewed in its broadest sense. Under the operation of an automated system, many activities necessary to the manual system will not be included but the functions performed by these activities will be included or will at least be implied. A few examples will serve to make this point clear.

The activity of filling out the night report will not be necessary as such under an automated system. Records of admissions will have been entered into the system at the time of the night admissions and any problems during the night will have been entered into the system with the activity 'report incident'. Any other information usually found in the night report will have been entered in a similar manner.

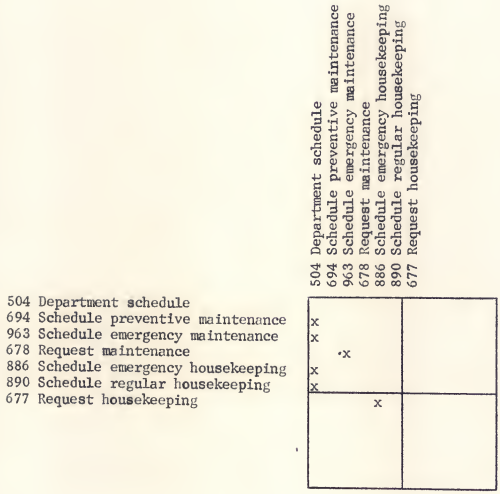

Figure 23. Maintenance and housekeeping subsystem matrix

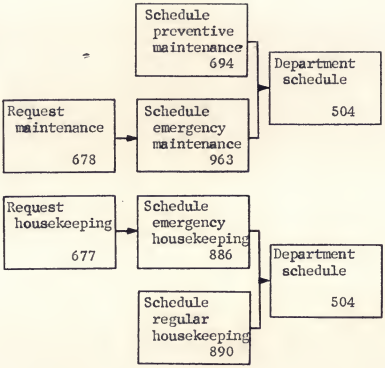

Figure 24. Maintenance and housekeeping subsystem flowchart

	505 Department expense	776 Generate payroll register	509 Personnel records	777 Update personnel record	962 Update personnel time	778 Update personnel position	850 Generate personnel action form	851 Compile statistics	852 Purge application file	853 Fill out application	976 Schedule personnel	504 Department schedule
505 Department expense												
776 Generate payroll register	X											
509 Personnel records		X						X				
777 Update personnel record			X									
962 Update personnel time				X								
778 Update personnel position			X									
850 Generate personnel action form							X					
851 Compile statistics												
852 Purge application file			X									
853 Fill out application								X				
976 Schedule personnel						X						
504 Department schedule											X	

Figure 25. Personnel subsystem matrix

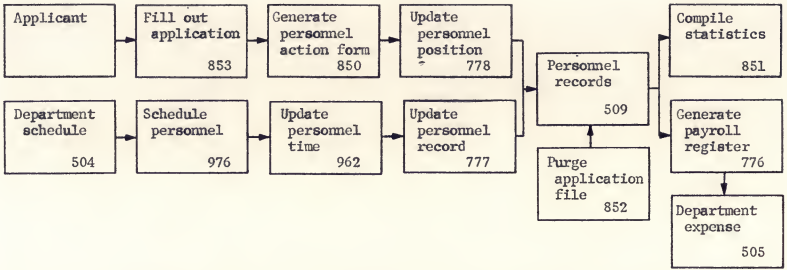

Figure 26. Personnel subsystem flowchart

The use of backup files on the patient floor to record medication schedules, diet orders, problems with the patient, and treatments, will not be required with the use of an automated system. All orders for medication and treatment as well as the patient's schedule will be used to generate reminders to the floor at the proper intervals during the day. When questions do arise, the ability to inquire into the system will make the use of these backup files redundant.

The activity of filing results of tests such a x-ray films, EKG tapes, or updating the tumor registry abstract are included under the activity, "report results." Conceptually, these data are all part of the medical record and will ultimately become part of the machine record.

Relations among subsystems

A matrix showing the departments from which each subsystem may receive inputs is of use in further analysis and is shown in Figure 27 All departments will not require access to each subsystem and the choice of the input device and the methods of entry may take advantage of this fact. Certain departments that transmit only numeric or codible data would not require the capability for entering narrative data and could thus use input devices capable of entering numeric data only.

The matrix of Figure 28 shows the organizational boundaries across which each subsystem functions. This matrix again illustrates the importance of system design without regard to departmental boundaries. If the information system is to be divided into functional subsystems it must be constrained by the departmental organization.

Interactions will appear between subsystems. The interaction will often be in the form of two subsystems accessing the same data in some

file. In other cases, one subsystem will set aside specified data which other subsystems may use as by-product data. In this manner, the billing and administrative reporting subsystems use data originated by other subsystems to accumulate a patient bill or statistics of the hospital's operation.

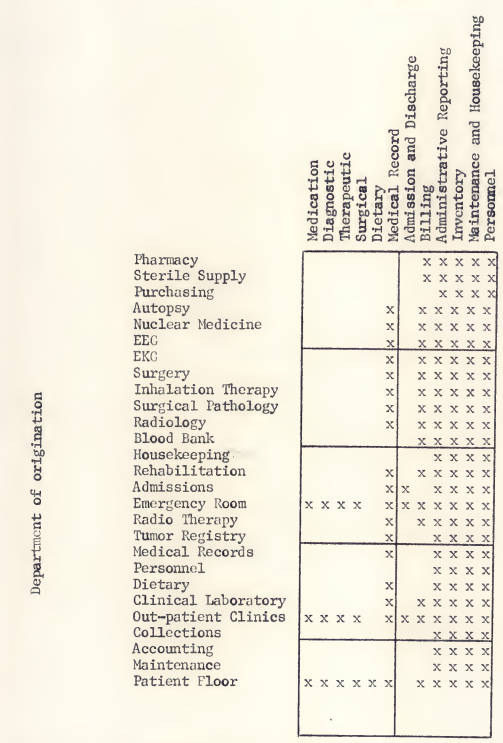

Figure 27. Origination of each subsystem in present departments

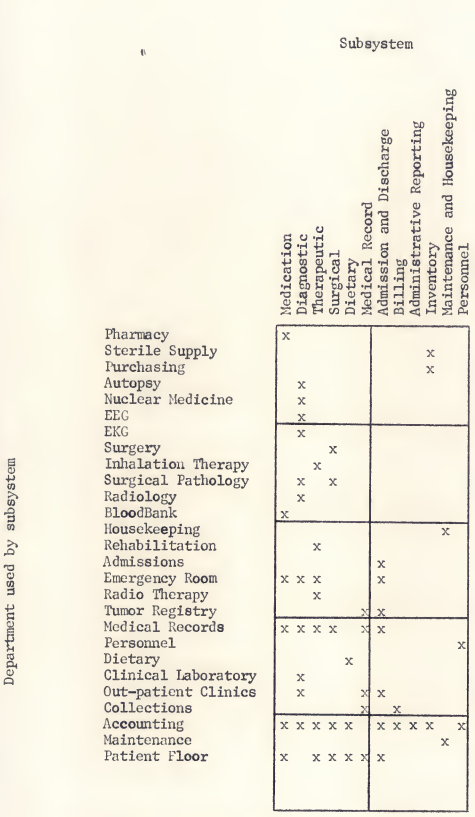

Figure 28. Departments comprising each subsystem

CHAPTER V

INTEGRATION OF THE HOSPITAL INFORMATION SYSTEM

The research has illustrated the general nature of the hospital information system. The last chapter formalized some basic concepts and facts of the operation of the hospital system. The objective of the next phase of the study is to utilize this knowledge to develop a conceptual framework of an integrated system. The definition of integration is again referred to as meaning the full co-ordination of the activities of the hospital under a homogeneous system rather than the mere automation of the existing system.

Goals of an Integrated Information System

Before beginning the development of the integrated system it will be useful to re-evaluate the goals of the hospital and show that the objectives of the integrated system are consistent with these goals.

Chapter I described a major goal of the hospital to be that of providing a high quality care to the patient. A second major goal of the modern teaching hospital is that of providing an atmosphere for learning and advancement of the science of medicine through research. This objective is most prevalent in the teaching hospital but is present to a degree in the general hospital in the form of the intern and resident system of teaching. A third major goal, that of operating within the revenue framework of the hospital is an objective shared with all

organizations. This objective seems to be in conflict with the other objectives of the hospital and in fact a balance between patient care and revenue must be kept.

The integrated system must certainly provide for the attainment of these basic objectives of the hospital. By its very nature, however, more can be expected from the integrated system.

Specifically, in the area of improved patient care, the integrated system should improve performance of the hospital because of its ability to collect, process, and disseminate information accurately and swiftly. Data are available on request and the need for transcribing large volumes of information is eliminated. The problems of loss of information and mistakes in transcription are reduced.

There is opportunity for cost savings under the operation of the integrated system. A large amount of the clerical work previously required of highly trained technical personnel would be assumed by the machine. Increasing personnel costs and the growing scarcity of trained personnel will make this aspect of the system inviting. The increased usage of optimizing techniques, which could be a part of the integrated system, provides the opportunity for significant cost savings. Optimizing techniques in scheduling, inventory, and other decision-making functions have been shown by industry to be worthwhile and are just beginning to be utilized in hospitals.

Integration of the Information system

The research has defined the basic characteristics and structure of the hospital decision and information system. The activities required

in the daily operation of the hospital were isolated and the information required for each activity was found. The activities were further grouped into functional subsystems which were shown to exhibit the property of crossing departmental boundaries of the hospital while carrying out the daily activities.

Sub-optimization

An implementation of an integrated information system must allow for this freedom of operation. Unfortunately, an organization places certain restraints on the way in which activities are carried out. Chapter III discussed the problem and suggested that a major obstacle to be overcome was that of sub-optimization of the total system. The objectives of the individual departments must not be permitted to supercede the over-all objectives of the hospital, and all activities should be planned with the hospital objectives forming the primary criteria of operation.

One form of sub-optimization which must be avoided in the hospital is the problem of the availability of one department to perform a service for another. Georgopoulous and Mann(7) pointed out that the functions of the hospital must be well co-ordinated if the system is to meet its objectives. The patient care floors would prefer immediate service to their requests to the diagnostic departments. Patient care might indeed be improved if this were made possible. The servicing of all requests on an emergency basis in the clinical laboratory would most likely be prohibitive in cost, however, and the objective of the laboratory to operate efficiently would not be met. The optimal combination of adequate patient care and operation within the revenue framework of the hospital should be approached.

Sub-optimization of an information system occurs frequently in regard to the movement, location of storage, and form of storage of data. Most of the information utilized within the system is a part of some central file similar to those illustrated in Table 1. The system must provide this information to remote locations while keeping an original record at the central location. The result, in most systems, is a preponderance of worksheets, backup copies, multipart forms, and memorandum records. If the data is not readily available from the central files, memorandum records are often maintained, resulting in much duplication of effort. Considerable study and integration of such a system often results in the improvement of these conditions. It is not, however, until the data of such a central file is placed at the disposal of remote locations in real-time that complete integration of a system can be approached.

Decision-making

Full integration of the hospital information system will not be possible until advanced techniques for carrying out the decision activity, as distinguished from the procedural activity, are incorporated into the system. The work to this point has provided only the basic framework of the decision and communication system. Few of the decision activities within the system are completed in a manner approaching optimal. Techniques for decision-making are available that will make a significant contribution to the over-all efficient operation of the hospital. It is not until these techniques are included in the operation of the hospital that full integration of the information system will be approached.

The availability of a central computing machine in conjunction with the availability of on-line information makes the problem of integrating these applications only that of the application of the techniques to the hospital environment. Many of the applications are very common to industry and need merely be integrated into the hospital structure.

Inventory control.--Large inventories are required for central stores, the pharmacy, the dietary department, housekeeping, and sterile supply among others. Each department has different criteria for stock-outs and maximum average inventory, making the use of standard inventory control techniques somewhat more difficult. The capability of handling the several criteria as well as forecasting the requirements of the hospital is inherent in the hardware but relatively little work has been done in setting up a functioning system. Experience in the industrial atmosphere indicates substantial savings are possible with the use of inventory control systems and has furnished the basic theory for the applications.

Scheduling.--The scheduling of patients, personnel, and plant within the hospital system is another application which should be integrated into the basic information system. The schedules of the three were shown to be very dependent in that the scheduling of one usually implies the scheduling of the remaining two. Because of this dependency scheduling of one department can seriously affect the schedules of other departments. The wrong choice of diet can force laboratory tests for a patient to be delayed a day while scheduling a patient for therapy conflicts with scheduling the patient for radiology. Approaching the

problem without taking into account all schedules will usually result in a sub-optimal solution.

The scheduling techniques must consider the time dependence of the activity within the hospital. The statistics of late arrival and non-arrival should be considered in the setting of the admission schedule and the average time and variance per operation or per test or treatment should be considered when setting the department schedules. An optimal schedule will result in increased utilization of plant and reduction of personnel. Scheduling is a critical and important activity in the hospital and existing theory should be integrated into the basic framework of the hospital information system.

The optimal dietary system.--The set of dietary functions was shown as an integral part of the hospital system. Attempts to optimize the operation of this department and its relations with other departments and the patient have been the subject of recent work. Fellers and Gue (6) have defined a total dietary system taking into account the functions of menu selection, purchasing, scheduling, and diet maintenance. This work promises to lead to substantial cost savings in the dietary department, but it must be emphasized that the dietary system must be integrated with the remainder of the hospital system. The dietary department does not stand alone and its functions must be integrated into those of the entire system to prevent sub-optimization.

Computer aided diagnosis.--The computer's decision-making and table-searching abilities are gradually being applied in the area of computer aided diagnosis. By allowing the machine to search through a symptom-diagnosis table, the possible diagnoses for a patient with given

symptoms can be isolated. If criteria functions are added, the "probable" diagnosis can be further delimited. These techniques have been shown to be practical in nuclear medicine and the relatively few diagnoses in psychiatry indicate that the diagnosis of mental illness might be possible.

Analysis of tests such as the electrocardiogram is an application to which the computer might be applied. Analyzing directly the analog output signal of the electrocardiograph and at least segregating suspect heart conditions on a high speed basis would bring the concept of mass-screening closer to the American public. These applications should be considered in the original integration of the system and provision made for their later inclusion.

Other administrative decisions.--A large amount of information concerning the operation of the hospital is available in the system and need only be captured and summarized in meaningful ways. The setting of the budget requirements requires the balancing of forecasts with past operational costs and performance statistics. The data for the latter two costs and for a projection of the first cost are available in the system and need only be accumulated and displayed. Criteria for the operation of the individual hospital may be set and monitored by the system, giving the administrator insights into his hospital as well as a close watch on its performance.

Other outputs from the integrated system will be an aid to decision-making. Departmental schedules are based on the availability of personnel and if the formal scheduling system is not able to schedule tests for lack of personnel, the administrator should be notified of the

problem. The importance of total integration is again pointed out by this example. Both scheduling and decision-making should be integrated into the system. Without this complete integration, portions of the system will be forced to operate in a sub-optimal manner resulting in sub-optimization of the total system.

Information retrieval

Techniques are being developed to utilize the large amounts of information available to the medical researcher. Improved methods for the acquisition, storage, and retrieval of this information will make possible an acceleration of the advancing technology of medicine. Until these services are provided in the information system of the hospital, the system will not approach full integration.

Data acquisition.--Many departments of the hospital produce data that must be entered into the medical record. The efficiency and accuracy of this process as well as the timeliness of the data would be improved were techniques of data acquisition developed. The clinical laboratory has numeric and codible data which must be entered into the record. Keyboards will provide the input for the numeric and portions of the codible information. Some of the codible data takes the form of analog signals and in present systems must be analyzed manually before a result is entered into the system. Hardware for the acquisition of this analog data could be utilized and analysis of the data undertaken by the computer. The lengthy manual procedure would thus be eliminated and the speed and accuracy of the computer utilized.

The use of physiological monitoring on the patient floor and in

the operating room promises to improve the operation of both locations. Not only can the patient's vital signs be displayed for an up-to-the-minute progress of the patient, but decisions can be made by the machine according to pre-set criteria and the exception data displayed. In this way, notification would be given only when the patient's condition reaches the pre-set limits and hospital personnel need not be continually monitoring the patient but can allow the machine to perform this monitoring. These applications are just being developed but the structure of the information should be such as to permit integration of these functions.

Research and the medical record.--One of the most exciting uses of the computing machine is the storage and retrieval of the medical record for the purposes of research. The existence of several large scale studies (16,2) into this area suggests the interest in the concept. The researcher would be able to insert a stream of logic into the machine in the form of patient identification data, symptoms, and diagnoses, and have the records searched for cases exhibiting the same relations. This methodology will replace the concept of manually searching through abstracts containing a limited amount of information and later pulling the actual medical records of suspect cases. The speed and large storage capacity of the computer will be at the disposal of the physician and will definitely provide a capability not previously available. The medical record must be integrated into the system in such a way as to provide for this searching capability. The information will be provided by the system and need only be added to the record to be available for inquiry.

Framework of an Automated Hospital Information System

The basic framework of an automated hospital information system has been suggested throughout the thesis. Much of the work in characterizing and defining the system was included to aid in the development of basic design of an automated system. The integration of advanced applications into the basic activity structure requires certain hardware configurations that may have been inferred from the discussion.

Generally, the automated system will take the form of Figure 29. The system will consist of a computer which will control the entire system, random access storage devices which will provide the large on-line storage required by the system, and remote terminals which will provide the input and output of information to and from the system.

The operation of the system will resemble that implied by Figure 4. That is, the functions of each subsystem will be provided by programs that may be called into the computer from the random access storage facility. A control program will schedule these subsystems according to the requirements of the system. Implications of the on-line storage devices and input-output considerations will now be studied in more detail.

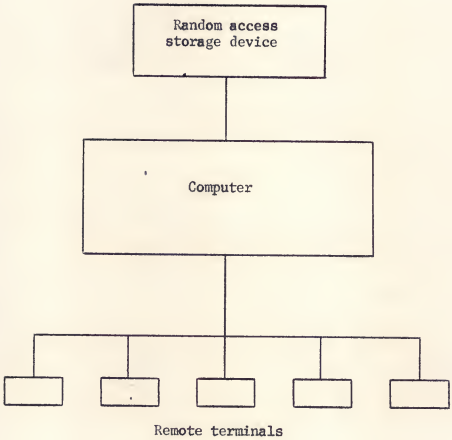

Figure 29. Basic schematic of an automated hospital information system

On-line record storage

Many facts of operation of the system suggest the need for an on-line set of central records.

The random nature of the majority of the activities lends to the efficient use of random access storage and a real-time system. The classification showed very few of the activities to be periodic, and many of them, especially physician's orders, must occur at random. The capability of random processing must be built into the hospital system. Certain activities might be handled on a batch-process basis or as background programs if their volume and importance does not warrant taking time from other random activity.

The large degree of utilization of the same information is an important justification of the centralization of the records. This utilization was illustrated by the relatively small number of different items of information inherent in the hospital. The same information is used repeatedly by many different activities originating in different departments. In present systems this requirement for the same information is met through the use of multiple copy forms. The automated system should not have to provide all of the information on a regular basis since it could be called forth randomly with an inquiry. This aspect of the problem of redundancy of information should be overcome with an automated system. Often, information is included on a form on the merest chance of its being used. In a paperwork system this is often an excellent technique for reducing telephone inquiries between departments of the hospital. The automated system in the form of an on-line storage system makes the use of inquiries the more efficient operation.

An on-line record system makes possible the efficient use of by-product data within the system. Many of the daily activities use data that was previously generated for some other purpose. A good example is the billing operation in which the bill is generated as a consequence of an order having been made to some department. The required information is inherent in the order and need not be generated anew for the purpose of billing. The fact that the records are randomly accessible makes it possible to immediately take this by-product data and update the patient's bill. In this same way the inventory system is affected by requests for issues; after the inventory is updated from the information generated by the request, the department is billed for the issue using the same information. This type of operation allows all records to be kept up-to-date which provides advantages to the system which are far reaching. Many reports reflecting the status of the system need not be generated if the status is open to inquiry and the records are up-to-date. Thus, a complete or detailed stock status report might not be required if the system were subject to inquiry and an inventory control system were integrated into the system. Similarly, if sufficient internal controls were utilized and the patient's bill was subject to inquiry, it might be possible to eliminate the detailed accounts receivable report.

The on-line random storage may be utilized to store schedules and other data of a temporary nature. Other data might be stored in batches and saved for later processing. This technique will become feasible if many large programs must be brought into core for the purpose of processing only a few sets of data. The time required to bring in the program might exceed that required to process the data, making batching of the data economical.

With so large a part of the records of the hospital internal to the machine and available upon recall, input to the system can be made more efficient. Thus, when it becomes necessary to charge an outpatient for a series of tests it will suffice to enter the patient's hospital number with the appropriate charge codes. The machine will perform the table lookup equating the charge codes with charges, affix the current date to the transaction, and update the patient's bill. The presently typical inputs were not required--those of further patient identification and those of further charge identification. Much of that data which was classified as available for control, but was not used, may be eliminated. Visual verification of the entry will be made at the department, assuring accurate input.

The development effort of Bolt, Beranek, and Newman (2) at the Massachusetts General Hospital illustrates the opportunities for utilizing the masses of data in the medical record were it on-line to the machine. Once the problems of communicating the logic of the physician's research to the machine are overcome, the data will be present for significant study. It would not be necessary to store all the data on-line, but historical data could be transferred to magnetic tape and could be used in later research in this form.

The opportunities in the area of management decision-making are almost as significant as those in medical research, and of more interest to a non-teaching hospital. Whereas much data that was previously available as by-product data was lost because of the massive problem of accumulating it, the machine could now extract the meaningful data and present accumulations of it to the administrator for decision-making. An advanced extension of this would be the use of true management by

exception to allow the machine to compare hospital operation statistics to pre-set criteria and notify the administrator only when the criteria are not met. This technique removes the burden from the administrator of sifting through massive reports and allows him to spend his time planning for the future.

Input-output

Efficient input-output to the system is most critical to the success of an automated hospital information system. The device used for this input-output must be located physically at the location originating the data and making use of the information system. The problem of training many people in the use of the device dictates the design of as simple and straight-forward a device as possible.

The computer will necessarily require its data in some coded form for use internally. The classifications of information show that most of the data is either in numerical form already or is in a form easily codible. The machine should be utilized where possible to code and decode this codible information. The use of the programmed keyboard is one approach which would make the encoding of the information on the part of the operator insignificant. Data which is not readily codible must be entered into the machine in its true form. A study of the classifications indicates that most information of this type is not originated on the patient floor but in certain diagnostic departments. This fact might lead to the use of the programmed keyboards on the floors and typewriter terminals or a combination of the two in the diagnostic departments.

Lake (12) has studied the problem of input to the system and has compared the operation of the major types of available input hardware. The conclusion reached by the study was that a typewriter keyboard input associated with a cathode ray tube readout device was the best method of accomplishing the input to the system. The major drawback to such a configuration is the high cost of the device and of the high speed communication lines required to service it.

The University of Texas Medical Branch in Galveston has chosen programmed keyboards for the input to the system. The major advantage of the programmed keyboard is the complex meaning which can be assigned to one key. Thus, one key can stand for a patient and his hospital number, another for a certain laboratory test, and another for the time of the request. The meaning of the keyboard is changed merely by replacing the keymat with another with all decoding of the keys handled by the computer.

The major problems in the use of the programmed keyboard are those of control of the keyboard assignments and the time required to change the keymat between transactions if such is required. Once the keymat is in place entry of information should be faster and more accurate than that using a typewriter keyboard.

A conclusion as to the optimal form of input to the system will not be made here. The problem has many facets; cost, accuracy, ease of operation, and speed of operation being only a few. Additional experience of industry with on-line information systems will begin to point to the preferrable approach to the input to the system.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Recent projects approaching the design and implementation of an automated information system for the general hospital have generally utilized the evolutionary technique of systems development. The studies have tended to concentrate on isolated areas and the subsequent automation applied only to portions of the hospital. The magnitude of the task of implementing such an automated system capable of serving most of the functions of the present system has been the primary cause of this evolutionary approach.

The implementation of an essentially revolutionary approach to the information system will require a thorough analysis of the requirements of the hospital system. This thesis has attempted to provide a basis for such an analysis and to furnish a basic understanding of the structure of the hospital system. Specifically, the research has accomplished the following:

1. The basic activities and informational requirements of the general hospital have been isolated and provided for further analysis.
2. Classification schemes which suggest relations within the system and provide implications toward the design of an automated

system have been applied to the activities and information in the system.

3. The information system has been divided into subsystems which are organized along functional boundaries rather than the organizational boundaries of the hospital.
4. The integration of decision-making and information retrieval techniques into the basic activity structure of the system has been considered. The importance of full integration of the functions of the system was stressed.
5. Finally, the basic framework for an automated hospital information system was proposed and the logic of its structure developed.

Hopefully, this research has provided a basis for further work in the development of a functional hospital information system. The scope of the problem of analyzing the total system is great, but the importance of utilizing this approach can not be over-emphasized.

Recommendations

The exploratory nature of the research makes it particularly suited as a basis for further research and development. Several studies indicative of the use of the research are suggested:

1. Utilization of the data in further quantitative approaches to system analysis.
2. Comparable studies in other hospitals to estimate the generality of the activities, information, and subsystems.
3. Study of the compatibility of the subsystems with the departmental organization.

4. Quantitative studies on the application of advanced decision-making techniques to the hospital system.
5. Design and application studies based upon the findings of the current research.

APPENDICES

APPENDIX I

DEPARTMENT CODES

Code	Department
01	Pharmacy
02	Sterile Supply
03	Purchasing
04	Autopsy
05	Nuclear Medicine
06	Not assigned
07	EEG
08	EKG
09	Surgery
10	Inhalation Therapy
11	Surgical Pathology
12	Radiology
13	Blood Bank
14	Housekeeping
15	Rehabilitation
16	Admissions
17	Emergency Room
18	Radio Therapy
19	Tumor Registry
20	Medical Records
21	Personnel
22	Dietary
23	Clinical Laboratories
24	Out-patient Clinics
25	Collections
26	Accounting
27	Maintenance
28	Patient Floors
96	Physician's orders
97	Diagnostic or Therapeutic Department
99	All Departments

APPENDIX II

LIST OF INFORMATION

Information Code	Information
001	ITEM DESCRIPTION
002	PATIENT NAME
003	ROUTE OR METHOD OF MEDICATION
004	DOSAGE SIZE OR QUANTITY
005	FREQUENCY OF MEDICATION
006	HOSPITAL DEPARTMENT
007	UNIT SIZE
008	QUANTITY
009	PHYSICIAN
010	CHARGE CODE
011	DOLLAR AMOUNT
012	HOSPITAL NUMBER
013	DEPARTMENT ACCOUNT NUMBER
014	CURRENT DATE
015	STOCK REORDER POINT
016	QUANTITY ON HAND
017	MEDICATION ADMINISTERED BY
018	HOSPITAL LOT NUMBER
019	TYPE OF SPECIMEN
020	STATEMENT OF PROBLEM
021	VENDOR LOT NUMBER
022	INGREDIENT
023	CHECKED BY
024	VENDOR NAME
025	STOCK NUMBER
026	VENDOR STOCK NUMBER
027	ACQUISITION NUMBER
028	PURCHASE ORDER NUMBER
029	APPROVAL
030	REORDER QUANTITY
031	SHELF NUMBER
032	ADDRESS
033	PRESCRIPTION NUMBER
034	ROOM NUMBER
035	PREPARATION REQUIRED FOR TEST
036	REGULAR HOURS WORKED
037	OVERTIME HOURS WORKED
038	VACATION TIME ACCUMULATED IN DAYS
039	EMPLOYEE NUMBER
040	PATIENT DESTINATION
041	MODE OF TRANSPORTATION
042	SCHEDULED TIME
043	AVERAGE USE STATISTICS
044	LIST OF ITEMS

045 DEPARTMENT SCHEDULE
046 PATIENT SCHEDULE
047 TEST OR TREATMENT ORDERED
048 MEDICAL SERVICE CODE
049 EXAMINATION NUMBER
050 PHYSICIANS REPORT
051 DECAY FACTOR
052 DECAY TIME IN DAYS
053 ORIGINAL STRENGTH
054 GUARANTOR NAME
055 RACE
056 DIAGNOSIS
057 EXPECTED DATE OF RECEIPT
058 DATE ORDERED
059 PRICE QUOTE NUMBER
060 NET CHANGE
061 RECEIPT NUMBER
062 EMPLOYEE NAME
063 TYPE OF OPERATION
064 ANESTHETIS
065 ANESTHESIA
066 CALL SCHEDULE
067 BLOOD TYPE
068 BLOOD GROUP
069 TIME REQUESTED
070 FORM OF REQUESTED BLOOD
071 THERAPY TREATMENT
072 THERAPIST
073 RESULTS
074 EQUIPMENT
075 AGE
076 SEX
077 PHONE NUMBER
078 VITAL SIGN RESULTS
079 SEROLOGY TEST NEGATIVE
080 CITY AND STATE
081 BLOOD BANK NAME
082 DONOR NAME
083 HOSPITAL NAME
084 PERSONNEL LIST WITH QUALIFICATIONS
085 DAILY HOUSEKEEPING REQUIREMENTS
086 LIST OF AVAILABLE BEDS
087 STOCK LOSS
088 HOUSE STAFF LIST
089 PATIENTS HOME COUNTY
090 INDIGENT SPONSOR ORGANIZATION
091 NUMBER OF VISITS AUTHORIZED
092 DOLLARS AUTHORIZED
093 INSURANCE COMPANY
094 ACQUISTION NUMBER LOG
095 DEPARTMENT ITEMIZED EXPENDITURES
096 DATE SCHEDULED
097 NOT ASSIGNED
098 NUMBER OF UNITS OF THERAPY
099 SOCIAL SECURITY NUMBER
100 OCCUPATION

101 CURRENT TIME
102 MARITAL STATUS
103 DATE OF BIRTH
104 CHURCH PREFERENCE
105 NAME OF SPOUSE
106 PARENTS NAME
107 EMPLOYER NAME
108 INSURANCE POLICY NUMBER
109 NAME-HOSPITAL NUMBER CROSS-REFERENCE
110 IBM NUMBER LOG
111 NUMBER OF DEPENDENTS
112 TOTAL INCOME
113 NUMBER PATIENTS ADMITTED
114 REFERRING PHYSICIAN
115 NAME OF WITNESS
116 TYPE OF TREATMENT
117 ESTIMATED HOSPITAL VISIT
118 REGISTRY NUMBER
119 DATE ADMITTED
120 DATE DISCHARGED
121 PHYSICIAN S ORDER
122 DATE OF EXPIRATION
123 DIAGNOSIS AT EXPIRATION
124 ARMED SERVICES HISTORY
125 HEIGHT
126 WEIGHT
127 EDUCATIONAL HISTORY
128 PROFESSIONAL REGISTRATION
129 EMPLOYMENT HISTORY
130 SALARY
131 LINE POSITION TITLE
132 DISCHARGE ANALYSIS WORKSHEET
133 DISCHARGE STATUS
134 DIET
135 MENU ITEM
136 COLOR CODE-TEST CROSS REFERENCE
137 NUMBER SPECIMENS REQUIRED
138 NUMBER OF MEALS TO HOLD
139 NURSE
140 INTERN
141 RESIDENT
142 FINANCIAL CODE
143 ALLOWABLE PATIENT COMMUNICATION
144 CURRENT PATIENT ITEMIZED BILL
145 DATE LAST BILLED
146 STATUS OF PAYMENT FROM INSURANCE COMPANY

APPENDIX III

LIST OF ACTIVITIES

Activity Code/ Information Code	Activity/ Information	Department Code	Activity Class/ Information Class
676	SCHEDULE PERSONNEL	99	21003
039	EMPLOYEE NUMBER		00000
062	EMPLOYEE NAME		20100
045	DEPARTMENT SCHEDULE		10100
677	REQUEST HOUSEKEEPING	99	21001
006	HOSPITAL DEPARTMENT		10000
020	STATEMENT OF PROBLEM		20000
034	ROOM NUMBER		00000
678	REQUEST MAINTENANCE	99	21001
006	HOSPITAL DEPARTMENT		10000
020	STATEMENT OF PROBLEM		20000
034	ROOM NUMBER		00000
679	ORDER OPERATION	96	10000
012	HOSPITAL NUMBER		00000
002	PATIENT NAME		20100
056	DIAGNOSIS		10000
069	TIME REQUESTED		00000
009	PHYSICIAN		10000
063	TYPE OF OPERATION		10000

680	BILL PATIENT	26	01000
002	PATIENT NAME		20100
032	ADDRESS		20100
144	CURRENT PATIENT ITEMIZED BILL		11100
681	ORDER SURGICAL PATHOLOGY	96	10000
002	PATIENT NAME		20103
056	DIAGNOSIS		10000
012	HOSPITAL NUMBER		00000
069	TIME REQUESTED		00000
047	TEST OR TREATMENT ORDERED		10000
009	PHYSICIAN		10000
682	ORDER AUTOPSY	96	10000
002	PATIENT NAME		20103
056	DIAGNOSIS		10000
012	HOSPITAL NUMBER		00000
069	TIME REQUESTED		00000
047	TEST OR TREATMENT ORDERED		10000
009	PHYSICIAN		10000
683	ORDER NUCLEAR DIAGNOSIS	96	10000
002	PATIENT NAME		20103
056	DIAGNOSIS		10000
012	HOSPITAL NUMBER		00000
069	TIME REQUESTED		00000
047	TEST OR TREATMENT ORDERED		10000
009	PHYSICIAN		10000
684	ORDER EKG	96	10000
002	PATIENT NAME		20103
056	DIAGNOSIS		10000
012	HOSPITAL NUMBER		00000
069	TIME REQUESTED		00000
047	TEST OR TREATMENT ORDERED		10000

009	PHYSICIAN		10000
685	ORDER EEG	96	10000
002	PATIENT NAME		20103
056	DIAGNOSIS		10000
012	HOSPITAL NUMBER		00000
069	TIME REQUESTED		00000
047	TEST OR TREATMENT ORDERED		10000
009	PHYSICIAN		10000
686	GENERATE ACCOUNTS PAYABLE	26	20002
028	PURCHASE ORDER NUMBER		00001
011	DOLLAR AMOUNT		01011
024	VENDOR NAME		20201
032	ADDRESS		20201
062	EMPLOYEE NAME		20201
039	EMPLOYEE NUMBER		00000
687	ORDER STERILE SUPPLY	28	10002
001	ITEM DESCRIPTION		20000
008	QUANTITY		01000
095	DEPARTMENT ITEMIZED EXPENDITURES		11100
013	DEPARTMENT ACCOUNT NUMBER		00100
144	CURRENT PATIENT ITEMIZED BILL		11100
688	GENERATE BUDGETARY STATUS	26	21013
013	DEPARTMENT ACCOUNT NUMBER		00100
095	DEPARTMENT ITEMIZED EXPENDITURES		11100
011	DOLLAR AMOUNT		01100
689	UPDATE DEPT REVENUE	26	21000
010	CHARGE CODE		10000
011	DOLLAR AMOUNT		01000

013	DEPARTMENT ACCOUNT NUMBER		00000
690	GENERATE A-R	26	20014
144	CURRENT PATIENT ITEMIZED BILL		11100
120	DATE DISCHARGED		00100
694	SCHEDULE PREVENT MAINTENANCE	27	21013
020	STATEMENT OF PROBLEM		20100
096	DATE SCHEDULED		00000
034	ROOM NUMBER		00100
695	SCHEDULE TECHNOLOGIST	09	21000
034	ROOM NUMBER		00000
035	PREPARATION REQUIRED FOR TEST		10100
047	TEST OR TREATMENT ORDERED		10100
002	PATIENT NAME		20100
045	DEPARTMENT SCHEDULE		10100
062	EMPLOYEE NAME		20100
696	REPORT TREATMENT AND RESULTS	09	10000
012	HOSPITAL NUMBER		00000
002	PATIENT NAME		20100
009	PHYSICIAN		10000
116	TYPE OF TREATMENT		10000
073	RESULTS		10000
050	PHYSICIANS REPORT		20000
697	UPDATE DEPARTMENT STATISTICS	09	20000
698	SEND FOR PATIENT	09	12000

002	PATIENT NAME		20100
034	ROOM NUMBER		00100
041	MODE OF TRANSPORTATION		10000
012	HOSPITAL NUMBER		00000
699	CHARGE PATIENT	09	00000
010	CHARGE CODE		10000
011	DOLLAR AMOUNT		01000
012	HOSPITAL NUMBER		00000
705	REPORT TREATMENT AND RESULTS	97	10000
012	HOSPITAL NUMBER		00000
002	PATIENT NAME		20100
009	PHYSICIAN		10000
116	TYPE OF TREATMENT		10000
073	RESULTS		10000
050	PHYSICIANS REPORT		20000
708	REQUEST CONSULT	96	11000
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
009	PHYSICIAN		10000
020	STATEMENT OF PROBLEM		20000
056	DIAGNOSIS		10000
096	DATE SCHEDULED		00000
709	CHARGE PATIENT	01	00000
010	CHARGE CODE		10000
011	DOLLAR AMOUNT		01000
012	HOSPITAL NUMBER		00000
002	PATIENT NAME		20100
710	INQUIRE FOR STOCK	03	22000

025	STOCK NUMBER		00000
001	ITEM DESCRIPTION		20100
008	QUANTITY		01000
007	UNIT SIZE		01100
714	REPORT RESULTS	04	10000
012	HOSPITAL NUMBER		00000
002	PATIENT NAME		20100
009	PHYSICIAN		10000
073	RESULTS		10000
050	PHYSICIANS REPORT		20000
014	CURRENT DATE		00100
715	CHARGE PATIENT	04	00000
010	CHARGE CODE		10000
011	DOLLAR AMOUNT		01000
012	HOSPITAL NUMBER		00000
719	SCHEDULE TECHNICIAN	11	21000
039	EMPLOYEE NUMBER		00000
062	EMPLOYEE NAME		20100
096	DATE SCHEDULED		00000
720	REPORT RESULTS	11	10000
012	HOSPITAL NUMBER		00000
002	PATIENT NAME		20100
009	PHYSICIAN		10000
073	RESULTS		10000
050	PHYSICIANS REPORT		20000
014	CURRENT DATE		00100
721	UPDATE DEPARTMENT STATISTICS	11	20000

722	CHARGE PATIENT	11	00000
010	CHARGE CODE		10000
011	DOLLAR AMOUNT		01000
012	HOSPITAL NUMBER		00000
723	UPDATE DEPARTMENT STATISTICS	13	20000
724	SCHEDULE TECHNICIAN	13	21000
034	ROOM NUMBER		00000
035	PREPARATION REQUIRED FOR TEST		10100
047	TEST OR TREATMENT ORDERED		10100
002	PATIENT NAME		20100
045	DEPARTMENT SCHEDULE		10100
062	EMPLOYEE NAME		20100
725	CHARGE PATIENT	13	00000
010	CHARGE CODE		10000
011	DOLLAR AMOUNT		01000
012	HOSPITAL NUMBER		00000
733	UPDATE DEPARTMENT STATISTICS	17	20000
012	HOSPITAL NUMBER		00000
014	CURRENT DATE		00100
056	DIAGNOSIS		10000
734	REPORT TREATMENT AND RESULTS	17	10000
012	HOSPITAL NUMBER		00000
002	PATIENT NAME		20100

009	PHYSICIAN	10100
116	TYPE OF TREATMENT	10100
073	RESULTS	10100
050	PHYSICIANS REPORT	20100

735	SCHEDULE TECHNICIAN	17	21000

034	ROOM NUMBER	00000
035	PREPARATION REQUIRED FOR TEST	10100
047	TEST OR TREATMENT ORDERED	10100
002	PATIENT NAME	20100
045	DEPARTMENT SCHEDULE	10100
062	EMPLOYEE NAME	20100

750	INQUIRE FOR HOSPITAL NUMBER	20	11000

002	PATIENT NAME	20000
032	ADDRESS	20000
076	SEX	10003
055	RACE	10003
075	AGE	00003

770	WRITE OFF PATIENT BILL	26	00004

002	PATIENT NAME	20100
012	HOSPITAL NUMBER	00100
011	DOLLAR AMOUNT	01100
029	APPROVAL	12100
120	DATE DISCHARGED	00100
142	FINANCIAL CODE	00100

771	CHARGE DEPARTMENT-ISSUES	26	20000

001	ITEM DESCRIPTION	20103
025	STOCK NUMBER	00100
008	QUANTITY	01100
007	UNIT SIZE	01100
006	HOSPITAL DEPARTMENT	10100
013	DEPARTMENT ACCOUNT NUMBER	00100

772	UPDATE INVENTORY-ISSUES	26	20000
001	ITEM DESCRIPTION		20103
025	STOCK NUMBER		00100
008	QUANTITY		01100
007	UNIT SIZE		01100
773	CHARGE DEPARTMENT-PURCHASE	26	20000
028	PURCHASE ORDER NUMBER		00100
001	ITEM DESCRIPTION		20103
025	STOCK NUMBER		00100
008	QUANTITY		01100
007	UNIT SIZE		01100
061	RECEIPT NUMBER		00103
013	DEPARTMENT ACCOUNT NUMBER		00100
006	HOSPITAL DEPARTMENT		10103
014	CURRENT DATE		00100
095	DEPARTMENT ITEMIZED EXPENDITURES		11100
774	AUTHORIZE PAYMENT-INVENTORY	26	20000
028	PURCHASE ORDER NUMBER		00100
001	ITEM DESCRIPTION		20103
025	STOCK NUMBER		00100
008	QUANTITY		01100
007	UNIT SIZE		01100
061	RECEIPT NUMBER		00100
024	VENDOR NAME		20100
032	ADDRESS		20100
775	UPDATE INVENTORY-RECEIPTS	26	20000
001	ITEM DESCRIPTION		20103
025	STOCK NUMBER		00000
008	QUANTITY		01100
007	UNIT SIZE		01100
776	GENERATE PAYROLL REGISTER	26	20014

062	EMPLOYEE NAME	20100
039	EMPLOYEE NUMBER	00000
006	HOSPITAL DEPARTMENT	10100
011	DOLLAR AMOUNT	01100
036	REGULAR HOURS WORKED	01100
037	OVERTIME HOURS WORKED	01100

777	UPDATE PERSONNEL RECORD	26	20012

062	EMPLOYEE NAME	20103
039	EMPLOYEE NUMBER	00100
036	REGULAR HOURS WORKED	01100
037	OVERTIME HOURS WORKED	01100
014	CURRENT DATE	00100
038	VACATION TIME ACCUMULATED IN DAYS	01100

778	UPDATE PERSONNEL POSITION	26	20002

062	EMPLOYEE NAME	20100
039	EMPLOYEE NUMBER	00000
130	SALARY	01000
029	APPROVAL	12000
131	LINE POSITION TITLE	20000
013	DEPARTMENT ACCOUNT NUMBER	00100

779	GENERATE FINAL BILL	26	00000

002	PATIENT NAME	20100
012	HOSPITAL NUMBER	00000
144	CURRENT PATIENT ITEMIZED BILL	11100
014	CURRENT DATE	00100
032	ADDRESS	20100

780	UPDATE PATIENT BILL	26	00000

012	HOSPITAL NUMBER	00000
010	CHARGE CODE	10100
011	DOLLAR AMOUNT	01100
014	CURRENT DATE	00100
144	CURRENT PATIENT ITEMIZED BILL	11100

781	INITIALIZE PATIENT BILL	26	00000
002	PATIENT NAME		20103
012	HOSPITAL NUMBER		00000
032	ADDRESS		20100
142	FINANCIAL CODE		00100
782	APPLY PAYMENTS	25	00000
002	PATIENT NAME		20103
012	HOSPITAL NUMBER		00000
011	DOLLAR AMOUNT		01000
144	CURRENT PATIENT ITEMIZED BILL		11100
783	FOLLOW UP PATIENT BILL	25	01000
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
120	DATE DISCHARGED		00000
146	STATUS OF PAYMENT FROM INSURANCE COMPANY		12000
784	BILL INSURANCE COMPANY	25	00000
002	PATIENT NAME		20000
032	ADDRESS		20100
093	INSURANCE COMPANY		20100
032	ADDRESS		20100
108	INSURANCE POLICY NUMBER		00100
075	AGE		00100
144	CURRENT PATIENT ITEMIZED BILL		11100
111	NUMBER OF DEPENDENTS		01100
009	PHYSICIAN		10100
119	DATE ADMITTED		00100
120	DATE DISCHARGED		00100
029	APPROVAL		12100
785	HOLD BILL FOR INSURANCE	25	01000
012	HOSPITAL NUMBER		00000
002	PATIENT NAME		20103

093	INSURANCE COMPANY		20100
144	CURRENT PATIENT ITEMIZED BILL		11100
786	INQUIRE FOR PATIENT BILL	25	01000
002	PATIENT NAME		20103
012	HOSPITAL NUMBER		00000
144	CURRENT PATIENT ITEMIZED BILL		11100
788	RELEASE FOR OPERATION	24	20000
014	CURRENT DATE		00100
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
063	TYPE OF OPERATION		10000
009	PHYSICIAN		10000
115	NAME OF WITNESS		20000
789	REPORT INCIDENT	99	20002
014	CURRENT DATE		00100
006	HOSPITAL DEPARTMENT		10000
002	PATIENT NAME		20000
032	ADDRESS		20000
020	STATEMENT OF PROBLEM		20000
115	NAME OF WITNESS		20000
062	EMPLOYEE NAME		20000
790	ORDER INPATIENT ADMISSION	24	10000
002	PATIENT NAME		20103
012	HOSPITAL NUMBER		00000
009	PHYSICIAN		10000
056	DIAGNOSIS		10000
096	DATE SCHEDULED		00000
042	SCHEDULED TIME		00000
791	REQUEST OTHER RECORD	20	11000

002	PATIENT NAME		20000
075	AGE		00100
120	DATE DISCHARGED		00000
083	HOSPITAL NAME		20000
029	APPROVAL		12000
792	REQUEST CONSULT	24	11000
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
009	PHYSICIAN		10000
020	STATEMENT OF PROBLEM		20000
056	DIAGNOSIS		10000
096	DATE SCHEDULED		00000
795	ORDER PRESCRIPTION	96	10000
002	PATIENT NAME		20103
012	HOSPITAL NUMBER		00000
001	ITEM DESCRIPTION		20000
004	DOSAGE SIZE OR QUANTITY		01000
005	FREQUENCY OF MEDICATION		01000
070	FORM OF REQUESTED BLOOD		10000
797	FILL OUT CHILDS WORKSHEET	28	11000
798	UPDATE CHILDS HISTORY	28	10000
799	INITIATE PLACENTAL RECORD	28	10001
800	FILL OUT BIRTH CERTIFICATE	28	10001

801	UPDATE LABOR-DELIVERY SUMMAR	28	10000
802	UPDATE PRENATAL RECORD	28	10000
806	OBTAIN SURGERY RELEASE	28	20000
002	PATIENT NAME		20000
115	NAME OF WITNESS		20000
807	COMPLETE PRE-OP CHECK	28	10000
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
101	CURRENT TIME		00100
029	APPROVAL		12000
808	FILL OUT MEAL TICKET	28	10212
142	FINANCIAL CODE		00100
089	PATIENTS HOME COUNTY		10100
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
010	CHARGE CODE		10000
011	DOLLAR AMOUNT		01000
809	TABULATE INTAKE-OUTPUT	28	10000
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
014	CURRENT DATE		00100
008	QUANTITY		01000
001	ITEM DESCRIPTION		20000

101	CURRENT TIME		00100
810	SEND PATIENT FOR TREATMENT	28	11000
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
046	PATIENT SCHEDULE		10100
101	CURRENT TIME		00100
811	RE-ORDER MEDICATION	28	10000
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
001	ITEM DESCRIPTION		20100
004	DOSAGE SIZE OR QUANTITY		01100
005	FREQUENCY OF MEDICATION		01100
007	UNIT SIZE		01100
009	PHYSICIAN		10100
812	TREAT ON FLOOR	28	10000
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
034	ROOM NUMBER		00100
116	TYPE OF TREATMENT		10100
009	PHYSICIAN		10100
139	NURSE		10100
813	PREPARE PATIENT-SURGERY	28	10000
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
121	PHYSICIAN S ORDER		10100
034	ROOM NUMBER		00100
814	OBTAIN SPECIMEN	28	10000

002	PATIENT NAME	20100
012	HOSPITAL NUMBER	00000
034	ROOM NUMBER	00100
047	TEST OR TREATMENT ORDERED	10100
019	TYPE OF SPECIMEN	10100
101	CURRENT TIME	00100

815	DISPENSE MEDICATION	28	10000

002	PATIENT NAME	20100
012	HOSPITAL NUMBER	00000
034	ROOM NUMBER	00100
001	ITEM DESCRIPTION	20100
004	DOSAGE SIZE OR QUANTITY	01100
005	FREQUENCY OF MEDICATION	01100

816	UPDATE GRAPHIC SUMMARY	28	10000

014	CURRENT DATE	00100
002	PATIENT NAME	20100
012	HOSPITAL NUMBER	00000
078	VITAL SIGN RESULTS	01000
101	CURRENT TIME	00100
001	ITEM DESCRIPTION	20000

817	SET UP CHART	28	11001

818	SET UP DESK FILE	28	11001

002	PATIENT NAME	20100
012	HOSPITAL NUMBER	00000
034	ROOM NUMBER	00100
048	MEDICAL SERVICE CODE	00100
009	PHYSICIAN	10000
140	INTERN	10000

819	UPDATE KARDEX	28	11000

121	PHYSICIAN S ORDER	10000
019	TYPE OF SPECIMEN	10000
116	TYPE OF TREATMENT	10000
134	DIET	10000
078	VITAL SIGN RESULTS	01000

820	SET UP KARDEX	28	11001
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
056	DIAGNOSIS		10100
119	DATE ADMITTED		00100
101	CURRENT TIME		00100

821	LOG PATIENT IN	28	11001
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
034	ROOM NUMBER		00100
048	MEDICAL SERVICE CODE		00100
141	RESIDENT		10000
014	CURRENT DATE		00100
075	AGE		00100
009	PHYSICIAN		10000
140	INTERN		10000
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
034	ROOM NUMBER		00100

822	ORDER DISCHARGE	96	10001
002	PATIENT NAME		20103
012	HOSPITAL NUMBER		00000
009	PHYSICIAN		10000

823	ORDER TRANSFER	96	10002
002	PATIENT NAME		20103
012	HOSPITAL NUMBER		00000
034	ROOM NUMBER		00000
048	MEDICAL SERVICE CODE		00000

009	PHYSICIAN		10000
824	ORDER OFF-FLOOR TREATMENT	96	10000
002	PATIENT NAME		20103
012	HOSPITAL NUMBER		00000
116	TYPE OF TREATMENT		10000
069	TIME REQUESTED		00000
005	FREQUENCY OF MEDICATION		01000
009	PHYSICIAN		10000
825	ORDER ON-FLOOR TREATMENT	96	10000
002	PATIENT NAME		20103
012	HOSPITAL NUMBER		00000
116	TYPE OF TREATMENT		10000
069	TIME REQUESTED		00000
005	FREQUENCY OF MEDICATION		01000
139	NURSE		10000
826	ORDER X-RAY	96	10000
002	PATIENT NAME		20103
012	HOSPITAL NUMBER		00000
047	TEST OR TREATMENT ORDERED		10000
069	TIME REQUESTED		00000
009	PHYSICIAN		10000
827	ORDER LAB TEST	96	10000
002	PATIENT NAME		20103
056	DIAGNOSIS		10000
012	HOSPITAL NUMBER		00000
069	TIME REQUESTED		00000
047	TEST OR TREATMENT ORDERED		10000
009	PHYSICIAN		10000
828	ORDER MEDICATION	96	10000

002	PATIENT NAME	20103
012	HOSPITAL NUMBER	00000
004	DOSAGE SIZE OR QUANTITY	01000
001	ITEM DESCRIPTION	20000
003	ROUTE OR METHOD OF MEDICATION	10000
005	FREQUENCY OF MEDICATION	01000
009	PHYSICIAN	10000
007	UNIT SIZE	01100
056	DIAGNOSIS	10000

829 ORDER DIET 96 10000

002	PATIENT NAME	20103
012	HOSPITAL NUMBER	00000
134	DIET	10000
138	NUMBER OF MEALS TO HOLD	01000
009	PHYSICIAN	10000

831 SET UP WORKSHEET 23 11000

027	ACQUISITION NUMBER	00100
047	TEST OR TREATMENT ORDERED	10100

832 ASSIGN ACQUISITION NUMBER 23 11000

002	PATIENT NAME	20103
012	HOSPITAL NUMBER	00000
094	ACQUISTION NUMBER LOG	10100

833 UPDATE SPECIMEN SCHEDULE 23 21012

047	TEST OR TREATMENT ORDERED	10000
019	TYPE OF SPECIMEN	10100
002	PATIENT NAME	20103
034	ROOM NUMBER	00100
012	HOSPITAL NUMBER	00000
137	NUMBER SPECIMENS REQUIRED	01000

834	ASSIGN COLOR CODE	23	11000
047	TEST OR TREATMENT ORDERED		10000
136	COLOR CODE-TEST CROSS REFERENCE		20100
137	NUMBER SPECIMENS REQUIRED		01000
835	SELECT MENU-PATIENT	22	21212
002	PATIENT NAME		20000
034	ROOM NUMBER		00100
134	DIET		10100
135	MENU ITEM		10000
014	CURRENT DATE		00100
838	TABULATE COOKING QUANTITIES	22	21012
135	MENU ITEM		10100
008	QUANTITY		01100
839	TABULATE MENUS	22	21012
135	MENU ITEM		10100
008	QUANTITY		01100
840	FILL OUT TRAY CARDS	22	11212
134	DIET		10100
002	PATIENT NAME		20100
034	ROOM NUMBER		00100
135	MENU ITEM		10100
841	UPDATE DIETARY STATISTICS	22	21012
134	DIET		10100
014	CURRENT DATE		00100
008	QUANTITY		01100
135	MENU ITEM		10100

842	UPDATE DIETARY RECORD	22	10000
134	DIET		10000
014	CURRENT DATE		00100
002	PATIENT NAME		20000
075	AGE		00103
056	DIAGNOSIS		10103
020	STATEMENT OF PROBLEM		20003
843	UPDATE PATIENT STATISTICS	20	11000
012	HOSPITAL NUMBER		00100
076	SEX		10100
055	RACE		10100
075	AGE		00100
133	DISCHARGE STATUS		10100
056	DIAGNOSIS		10100
065	ANESTHESIA		10100
116	TYPE OF TREATMENT		10100
063	TYPE OF OPERATION		10100
117	ESTIMATED HOSPITAL VISIT		01100
095	DEPARTMENT ITEMIZED EXPENDITURES		11100
120	DATE DISCHARGED		00100
844	CHECK RECORD COMPLETION	20	11000
002	PATIENT NAME		20103
012	HOSPITAL NUMBER		00000
009	PHYSICIAN		10100
120	DATE DISCHARGED		00100
132	DISCHARGE ANALYSIS WORKSHEET		20101
845	AUTHORIZE INFO RELEASE	20	20000
002	PATIENT NAME		20000
075	AGE		00100
014	CURRENT DATE		00100
029	APPROVAL		12000

846	UPDATE RECORD LOCATION FILE	20	21000
002	PATIENT NAME		20103
012	HOSPITAL NUMBER		00000
014	CURRENT DATE		00100
009	PHYSICIAN		10000
006	HOSPITAL DEPARTMENT		10000
847	UPDATE CROSS-REFERENCE FILE	20	11000
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00100
032	ADDRESS		20100
119	DATE ADMITTED		00100
075	AGE		00100
142	FINANCIAL CODE		00100
055	RACE		10100
089	PATIENTS HOME COUNTY		10100
848	GENERATE ID PLATE	20	11000
002	PATIENT NAME		20100
032	ADDRESS		20100
012	HOSPITAL NUMBER		00100
119	DATE ADMITTED		00100
075	AGE		00100
142	FINANCIAL CODE		00100
055	RACE		10100
089	PATIENTS HOME COUNTY		10100
849	UPDATE KARDEX	21	21000
099	SOCIAL SECURITY NUMBER		00100
103	DATE OF BIRTH		00100
002	PATIENT NAME		20100
032	ADDRESS		20100
039	EMPLOYEE NUMBER		00100
014	CURRENT DATE		00100
100	OCCUPATION		10100
006	HOSPITAL DEPARTMENT		10100
013	DEPARTMENT ACCOUNT NUMBER		00100

850	GENERATE PERSON. ACTION FORM	21	20000
013	DEPARTMENT ACCOUNT NUMBER		00100
131	LINE POSITION TITLE		20100
100	OCCUPATION		10100
130	SALARY		01100
099	SOCIAL SECURITY NUMBER		00100
002	PATIENT NAME		20100
055	RACE		10100
103	DATE OF BIRTH		00100
029	APPROVAL		12100
851	COMPILE STATISTICS	21	21002
002	PATIENT NAME		20100
099	SOCIAL SECURITY NUMBER		00100
130	SALARY		01100
103	DATE OF BIRTH		00100
076	SEX		10100
055	RACE		10100
014	CURRENT DATE		00100
100	OCCUPATION		10100
006	HOSPITAL DEPARTMENT		10100
013	DEPARTMENT ACCOUNT NUMBER		00100
852	PURGE APPLICATION FILE	21	20013
014	CURRENT DATE		00100
853	FILL OUT APPLICATION	21	20000
075	AGE		00000
076	SEX		10000
102	MARITAL STATUS		10000
111	NUMBER OF DEPENDENTS		01000
125	HEIGHT		00000
126	WEIGHT		00000
014	CURRENT DATE		00100
099	SOCIAL SECURITY NUMBER		00000
062	EMPLOYEE NAME		20000
032	ADDRESS		20000
077	PHONE NUMBER		00000
124	ARMED SERVICES HISTORY		10000

100	OCCUPATION		10000
107	EMPLOYER NAME		20000
127	EDUCATIONAL HISTORY		10000
128	PROFESSIONAL REGISTRATION		10000
129	EMPLOYMENT HISTORY		10000
854	COMPILE STATISTICS	19	20012
855	FOLLOW-UP PATIENT	19	10012
002	PATIENT NAME		20100
032	ADDRESS		20100
076	SEX		10100
055	RACE		10100
075	AGE		00100
056	DIAGNOSIS		10100
118	REGISTRY NUMBER		00100
012	HOSPITAL NUMBER		00100
122	DATE OF EXPIRATION		00100
123	DIAGNOSIS AT EXPIRATION		10100
120	DATE DISCHARGED		00100
014	CURRENT DATE		00100
856	UPDATE FOLLOW-UP FILE	19	11002
002	PATIENT NAME		20103
032	ADDRESS		20103
089	PATIENTS HOME COUNTY		10103
012	HOSPITAL NUMBER		00000
118	REGISTRY NUMBER		00100
075	AGE		00103
056	DIAGNOSIS		10003
120	DATE DISCHARGED		00000
857	UPDATE ABSTRACT	19	10002
002	PATIENT NAME		20100
032	ADDRESS		20100
118	REGISTRY NUMBER		00100
119	DATE ADMITTED		00100

120	DATE DISCHARGED	00100
103	DATE OF BIRTH	00100
055	RACE	10100
102	MARITAL STATUS	10100
012	HOSPITAL NUMBER	00100
056	DIAGNOSIS	10100
116	TYPE OF TREATMENT	10100
014	CURRENT DATE	00100

858 APPLY FOR PROGRAM 19 00002

002	PATIENT NAME	20000
032	ADDRESS	20000
055	RACE	10000
076	SEX	10000
075	AGE	00000
093	INSURANCE COMPANY	20000
115	NAME OF WITNESS	20000
009	PHYSICIAN	10000
056	DIAGNOSIS	10000
117	ESTIMATED HOSPITAL VISIT	01000

859 APPLY FOR TRAVEL 19 00002

002	PATIENT NAME	20000
032	ADDRESS	20110
041	MODE OF TRANSPORTATION	10000
096	DATE SCHEDULED	00000
011	DOLLAR AMOUNT	01000
117	ESTIMATED HOSPITAL VISIT	01000

860 APPLY FOR EXAMINATION 19 00002

014	CURRENT DATE	00000
002	PATIENT NAME	20000
075	AGE	00000
055	RACE	10000
076	SEX	10000
102	MARITAL STATUS	10000
032	ADDRESS	20000
056	DIAGNOSIS	10000
009	PHYSICIAN	10000
112	TOTAL INCOME	01000
029	APPROVAL	12000

862	REQUEST OUT-PATIENT APPOINT	18	11002
002	PATIENT NAME		20103
032	ADDRESS		20103
012	HOSPITAL NUMBER		00000
009	PHYSICIAN		10000
042	SCHEDULED TIME		00000
096	DATE SCHEDULED		00000
863	GENERATE TUMOR REPORT	18	11001
002	PATIENT NAME		20003
012	HOSPITAL NUMBER		00100
009	PHYSICIAN		10100
056	DIAGNOSIS		10100
116	TYPE OF TREATMENT		10100
864	FILL OUT HOSPITAL RELEASE	18	20001
002	PATIENT NAME		20000
014	CURRENT DATE		00100
115	NAME OF WITNESS		20000
009	PHYSICIAN		10000
865	OBTAIN HOSPITAL RELEASE	16	20000
002	PATIENT NAME		20000
014	CURRENT DATE		00000
115	NAME OF WITNESS		20000
866	FILL OUT STATE REGISTRY FORM	17	20000
867	FILL OUT WKMN COMPENSATION	17	20000

868	COMPLETE HOSPITAL RELEASE	17	20000
002	PATIENT NAME		20000
014	CURRENT DATE		00100
115	NAME OF WITNESS		20000
869	DISCHARGE PATIENT	17	10000
002	PATIENT NAME		20103
012	HOSPITAL NUMBER		00000
101	CURRENT TIME		00000
056	DIAGNOSIS		10100
009	PHYSICIAN		10000
870	REQUEST OUT-PAT. APPOINTMENT	17	11000
002	PATIENT NAME		20103
032	ADDRESS		20103
012	HOSPITAL NUMBER		00000
096	DATE SCHEDULED		00000
042	SCHEDULED TIME		00000
009	PHYSICIAN		10000
871	CHARGE PATIENT	17	00000
010	CHARGE CODE		10000
011	DOLLAR AMOUNT		01000
012	HOSPITAL NUMBER		00000
002	PATIENT NAME		20103
872	REQUEST HOSPITAL NUMBER	17	10000
002	PATIENT NAME		20000
032	ADDRESS		20100
076	SEX		10103
055	RACE		10103
075	AGE		00103

873	REQUEST MEDICAL RECORD	17	11000
002	PATIENT NAME		20003
012	HOSPITAL NUMBER		00000
874	OBTAIN ADMITTING INFORMATION	17	10000
099	SOCIAL SECURITY NUMBER		00000
076	SEX		10000
055	RACE		10000
102	MARITAL STATUS		10000
002	PATIENT NAME		20000
012	HOSPITAL NUMBER		00000
101	CURRENT TIME		00000
032	ADDRESS		20000
054	GUARANTOR NAME		20000
032	ADDRESS		20000
114	REFERRING PHYSICIAN		20000
032	ADDRESS		20000
029	APPROVAL		12000
093	INSURANCE COMPANY		20000
108	INSURANCE POLICY NUMBER		00000
103	DATE OF BIRTH		00000
075	AGE		00000
104	CHURCH PREFERENCE		10000
875	COMPLETE NIGHT REPORT	16	21012
014	CURRENT DATE		00100
020	STATEMENT OF PROBLEM		20000
039	EMPLOYEE NUMBER		00000
113	NUMBER PATIENTS ADMITTED		01000
876	ASSIGN FINANCIAL CODE	16	00000
002	PATIENT NAME		20000
112	TOTAL INCOME		01000

877	UPDATE CENSUS	16	21000
142	FINANCIAL CODE		00100
009	PHYSICIAN		10000
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
034	ROOM NUMBER		00000
095	DEPARTMENT ITEMIZED EXPENDITURES		11100
878	OBTAIN FINANCIAL DATA	16	00000
002	PATIENT NAME		20000
054	GUARANTOR NAME		20100
100	OCCUPATION		10100
111	NUMBER OF DEPENDENTS		01000
112	TOTAL INCOME		01000
099	SOCIAL SECURITY NUMBER		00100
029	APPROVAL		12000
093	INSURANCE COMPANY		20000
108	INSURANCE POLICY NUMBER		00000
142	FINANCIAL CODE		00100
009	PHYSICIAN		10000
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00000
034	ROOM NUMBER		00000
048	MEDICAL SERVICE CODE		00100
879	APPLY FOR PROGRAM	16	00001
002	PATIENT NAME		20000
032	ADDRESS		20100
055	RACE		10100
076	SEX		10100
083	HOSPITAL NAME		20100
056	DIAGNOSIS		10100
009	PHYSICIAN		10000
075	AGE		00100
093	INSURANCE COMPANY		20100
032	ADDRESS		20100
108	INSURANCE POLICY NUMBER		00100
881	REQUEST HOSPITAL NUMBER	16	10000

002	PATIENT NAME	20000
032	ADDRESS	20100
076	SEX	10103
055	RACE	10103
075	AGE	00103
109	NAME-HOSPITAL NUMBER CROSS-REFERENCE	20100

882	OBTAIN AVAILABLE BED	16	10000

048	MEDICAL SERVICE CODE	00000
086	LIST OF AVAILABLE BEDS	10100

883	OBTAIN ADMITTING INFORMATION	16	20000

032	ADDRESS	20000
106	PARENTS NAME	20000
107	EMPLOYER NAME	20000
032	ADDRESS	20000
009	PHYSICIAN	10000
103	DATE OF BIRTH	00000
105	NAME OF SPOUSE	20000
077	PHONE NUMBER	00000
032	ADDRESS	20000
076	SEX	10000
055	RACE	10000
102	MARITAL STATUS	10000
101	CURRENT TIME	00100
099	SOCIAL SECURITY NUMBER	00000
056	DIAGNOSIS	10000
054	GUARANTOR NAME	20000
100	OCCUPATION	10000
048	MEDICAL SERVICE CODE	00000
100	OCCUPATION	10000
032	ADDRESS	20000
014	CURRENT DATE	00100
108	INSURANCE POLICY NUMBER	00000
114	REFERRING PHYSICIAN	20000
002	PATIENT NAME	20000

885	UPDATE WORK FILE	15	21001

002	PATIENT NAME	20000
012	HOSPITAL NUMBER	00000
056	DIAGNOSIS	10000

009	PHYSICIAN	10000
096	DATE SCHEDULED	00000
071	THERAPY TREATMENT	10000

886	SCHEDULE EMERGENCY HOUSEKEEP	14	21000

020	STATEMENT OF PROBLEM	20201
069	TIME REQUESTED	00001
039	EMPLOYEE NUMBER	00000
084	PERSONNEL LIST WITH QUALIFICATIONS	10101
034	ROOM NUMBER	00001

887	CHECK AUTHORIZATION	15	00001

002	PATIENT NAME	20100
012	HOSPITAL NUMBER	00000
089	PATIENTS HOME COUNTY	10103
090	INDIGENT SPONSOR ORGANIZATION	10100
032	ADDRESS	20103
009	PHYSICIAN	10103
091	NUMBER OF VISITS AUTHORIZED	01100
092	DOLLARS AUTHORIZED	01100
093	INSURANCE COMPANY	20100

888	CHECK REQUEST VALIDITY	97	11000

009	PHYSICIAN	10000
088	HOUSE STAFF LIST	10100
141	RESIDENT	10000
140	INTERN	10000

889	UPDATE INVENTORY	14	20002

087	STOCK LOSS	11000
001	ITEM DESCRIPTION	20000

890	SCHEDULE REGULAR HOUSEKEEP.	14	21012

084	PERSONNEL LIST WITH QUALIFICATIONS	10100
085	DAILY HOUSEKEEPING REQUIREMENTS	11100
046	PATIENT SCHEDULE	10100
086	LIST OF AVAILABLE BEDS	10100

891	OBTAIN OPERATING PERMISSION	09	20000

002	PATIENT NAME	20000
014	CURRENT DATE	00100
015	STOCK REORDER POINT	01000

892	COMPLETE BLOOD SHIPMENT	13	20003

081	BLOOD BANK NAME	20000
083	HOSPITAL NAME	20000
032	ADDRESS	20000
067	BLOOD TYPE	10100
068	BLOOD GROUP	10100
079	SEROLOGY TEST NEGATIVE	10100

893	CREDIT BLOOD TO BANK	13	20002

081	BLOOD BANK NAME	20000
032	ADDRESS	20000
082	DONOR NAME	20100
002	PATIENT NAME	20000
083	HOSPITAL NAME	20000
014	CURRENT DATE	00100

894	UPDATE CROSS-INDEX	13	11000

082	DONOR NAME	20000
067	BLOOD TYPE	10000
068	BLOOD GROUP	10000

895	UPDATE RECIPIENT RECORD	13	10000

002	PATIENT NAME	20100
012	HOSPITAL NUMBER	00000
067	BLOOD TYPE	10000
068	BLOOD GROUP	10000
014	CURRENT DATE	00100
008	QUANTITY	01000

896	PAY DONOR	13	20001
082	DONOR NAME		20000
029	APPROVAL		12000
011	DOLLAR AMOUNT		01000
013	DEPARTMENT ACCOUNT NUMBER		00100
010	CHARGE CODE		10000

897	FILL BLOOD ORDER	13	10001
002	PATIENT NAME		20000
067	BLOOD TYPE		10000
068	BLOOD GROUP		10000
070	FORM OF REQUESTED BLOOD		10000
034	ROOM NUMBER		00000

898	GENERATE DONOR RECORD	13	10002
082	DONOR NAME		20000
075	AGE		00000
076	SEX		10000
055	RACE		10000
032	ADDRESS		20000
077	PHONE NUMBER		00000

899	CALL DONOR	13	12001
082	DONOR NAME		20000
077	PHONE NUMBER		00100

900	UPDATE DONOR RECORD	13	10000

078	VITAL SIGN RESULTS		01000
079	SEROLOGY TEST NEGATIVE		10000
067	BLOOD TYPE		10000
068	BLOOD GROUP		10000
014	CURRENT DATE		00100
082	DONOR NAME		20000
902	UPDATE AVAILIABILITY FILE	13	11000
067	BLOOD TYPE		10000
068	BLOOD GROUP		10000
070	FORM OF REQUESTED BLOOD		10000
082	DONOR NAME		20000
903	CHECK AVAILIABILITY FILE	13	11000
067	BLOOD TYPE		10000
068	BLOOD GROUP		10000
070	FORM OF REQUESTED BLOOD		10000
904	SEND FOR SPECIMEN	13	10000
002	PATIENT NAME		20100
034	ROOM NUMBER		00100
905	CALL IN TECHNOLOGIST	12	22002
066	CALL SCHEDULE		10100
062	EMPLOYEE NAME		20100
077	PHONE NUMBER		00100
014	CURRENT DATE		00100
906	UPDATE CALL SCHEDULE	12	21004
062	EMPLOYEE NAME		20000
066	CALL SCHEDULE		10100
096	DATE SCHEDULED		00000
042	SCHEDULED TIME		00000

907	CHECK OUT FILMS	12	11000
012	HOSPITAL NUMBER		00000
009	PHYSICIAN		10000
014	CURRENT DATE		00100
908	FILE FILMS	12	10000
012	HOSPITAL NUMBER		00000
909	SCHEDULE TECHNOLOGIST	97	21000
034	ROOM NUMBER		00000
035	PREPARATION REQUIRED FOR TEST		10100
047	TEST OR TREATMENT ORDERED		10100
002	PATIENT NAME		20100
045	DEPARTMENT SCHEDULE		10100
062	EMPLOYEE NAME		20100
911	ORDER X-RAY FILMS	09	11000
012	HOSPITAL NUMBER		00000
912	SEND PATHOLOGICAL SPECIMEN	09	11000
002	PATIENT NAME		20000
056	DIAGNOSIS		10000
019	TYPE OF SPECIMEN		10000
913	UPDATE DIAGNOSIS FILE	11	21001
012	HOSPITAL NUMBER		00100
056	DIAGNOSIS		10100

914	UPDATE CROSS-INDEX	11	21001
002	PATIENT NAME		20100
012	HOSPITAL NUMBER		00100
915	FILE WET SPECIMEN	11	12001
012	HOSPITAL NUMBER		00000
916	FILE SLIDES	11	12001
012	HOSPITAL NUMBER		00000
917	LOG TEST IN	97	21001
002	PATIENT NAME		20103
012	HOSPITAL NUMBER		00000
047	TEST OR TREATMENT ORDERED		10100
101	CURRENT TIME		00100
918	UPDATE CALL SCHEDULE	09	21004
062	EMPLOYEE NAME		20000
066	CALL SCHEDULE		10100
096	DATE SCHEDULED		00000
042	SCHEDULED TIME		00000
919	CALL IN NURSE	09	22002
066	CALL SCHEDULE		10100
062	EMPLOYEE NAME		20100
077	PHONE NUMBER		00100
014	CURRENT DATE		00100

920	UPDATE O R SCHEDULE	09	21000
069	TIME REQUESTED		00000
034	ROOM NUMBER		00000
002	PATIENT NAME		20103
012	HOSPITAL NUMBER		00000
063	TYPE OF OPERATION		10000
009	PHYSICIAN		10000
065	ANESTHESIA		10000
921	ORDER STERILE SUPPLY	09	10002
001	ITEM DESCRIPTION		20000
008	QUANTITY		01000
922	ORDER LAB TEST	09	10001
047	TEST OR TREATMENT ORDERED		10000
069	TIME REQUESTED		00000
009	PHYSICIAN		10000
002	PATIENT NAME		20100
034	ROOM NUMBER		00000
012	HOSPITAL NUMBER		00000
923	ORDER MEDICATION	09	10000
003	ROUTE OR METHOD OF MEDICATION		10000
001	ITEM DESCRIPTION		20000
004	DOSAGE SIZE OR QUANTITY		01000
005	FREQUENCY OF MEDICATION		01000
002	PATIENT NAME		20100
034	ROOM NUMBER		00000
009	PHYSICIAN		10000
012	HOSPITAL NUMBER		00000
924	ORDER X-RAY	09	10001
047	TEST OR TREATMENT ORDERED		10000
069	TIME REQUESTED		00000
002	PATIENT NAME		20103

034	ROOM NUMBER	00000
009	PHYSICIAN	10000
012	HOSPITAL NUMBER	00000

925	ORDER BLOOD	09	10001

034	ROOM NUMBER	00000
067	BLOOD TYPE	10000
068	BLOOD GROUP	10000
070	FORM OF REQUESTED BLOOD	10000
009	PHYSICIAN	10000
008	QUANTITY	01000
069	TIME REQUESTED	00000
012	HOSPITAL NUMBER	00000

926	NURSE SIGN IN	09	21002

039	EMPLOYEE NUMBER	00010
062	EMPLOYEE NAME	20113

927	PHYSICIAN SIGN IN	09	21000

009	PHYSICIAN	10010
141	RESIDENT	10010
140	INTERN	10010

928	FILE GRAPH	07	10001

012	HOSPITAL NUMBER	00100

930	GENERATE ABSTRACT	07	11001

012	HOSPITAL NUMBER	00000
002	PATIENT NAME	20100
014	CURRENT DATE	00100
075	AGE	00100
076	SEX	10100
048	MEDICAL SERVICE CODE	00100

056	DIAGNOSIS		10000
931	FILE PHONO TAPE	08	10000
012	HOSPITAL NUMBER		00100
932	FILE VECTOR FILMS	08	10000
012	HOSPITAL NUMBER		00100
933	UPDATE DIAGNOSIS FILE	08	11000
012	HOSPITAL NUMBER		00000
056	DIAGNOSIS		10000
934	FILE EKG TAPE	08	10000
012	HOSPITAL NUMBER		00100
936	RECORD THERAPY	10	11000
074	EQUIPMENT		10000
014	CURRENT DATE		00100
002	PATIENT NAME		20100
071	THERAPY TREATMENT		10000
073	RESULTS		10000
034	ROOM NUMBER		00000
042	SCHEDULED TIME		00100
010	CHARGE CODE		10000
011	DOLLAR AMOUNT		01000
012	HOSPITAL NUMBER		00000
939	UPDATE CROSS REFERENCE	03	21001

028	PURCHASE ORDER NUMBER		00000
024	VENDOR NAME		20000
940	CHECK FOR RECEIPT	03	21002
028	PURCHASE ORDER NUMBER		00000
057	EXPECTED DATE OF RECEIPT		00100
014	CURRENT DATE		00100
941	FOLLOW UP PURCHASE ORDER	03	21002
028	PURCHASE ORDER NUMBER		00000
058	DATE ORDERED		00100
014	CURRENT DATE		00100
024	VENDOR NAME		20100
032	ADDRESS		20100
942	CHECK STOCK LEVEL	03	21002
025	STOCK NUMBER		00000
001	ITEM DESCRIPTION		20201
007	UNIT SIZE		01011
016	QUANTITY ON HAND		01010
945	GENERATE P O ADJUSTMENT	03	20003
028	PURCHASE ORDER NUMBER		00000
058	DATE ORDERED		00100
026	VENDOR STOCK NUMBER		00100
001	ITEM DESCRIPTION		20100
007	UNIT SIZE		01100
008	QUANTITY		01000
024	VENDOR NAME		20100
032	ADDRESS		20100
029	APPROVAL		12000
946	INITIATE PURCHASE ORDER	03	20001

025	STOCK NUMBER	00000
001	ITEM DESCRIPTION	20100
008	QUANTITY	01000
007	UNIT SIZE	01100
026	VENDOR STOCK NUMBER	00000
057	EXPECTED DATE OF RECEIPT	00000
006	HOSPITAL DEPARTMENT	10100
013	DEPARTMENT ACCOUNT NUMBER	00000
029	APPROVAL	12000
024	VENDOR NAME	20000
032	ADDRESS	20100
011	DOLLAR AMOUNT	01000

947	UPDATE DIAGNOSIS FILE	04	11002
012	HOSPITAL NUMBER		00000
056	DIAGNOSIS		10000

948	FILE SLIDES	04	10002
012	HOSPITAL NUMBER		00100

949	OBTAIN PERMISSION	04	20002
002	PATIENT NAME		20000
014	CURRENT DATE		00100
115	NAME OF WITNESS		20000

950	CALCULATE DOSAGE	05	10001
001	ITEM DESCRIPTION		20000
004	DOSAGE SIZE OR QUANTITY		01000
051	DECAY FACTOR		01100
052	DECAY TIME IN DAYS		01000
053	ORIGINAL STRENGTH		01000

955	FILE FILMS	05	10000

012	HOSPITAL NUMBER		00100
956	UPDATE DEPARTMENT STATISTICS	97	20000
957	UPDATE DEPARTMENT SCHEDULE	97	21000
012	HOSPITAL NUMBER		00000
002	PATIENT NAME		20100
042	SCHEDULED TIME		00000
047	TEST OR TREATMENT ORDERED		10000
034	ROOM NUMBER		00100
096	DATE SCHEDULED		00000
958	SEND FOR PATIENT	97	12000
002	PATIENT NAME		20100
034	ROOM NUMBER		00100
041	MODE OF TRANSPORTATION		10000
012	HOSPITAL NUMBER		00000
959	SCHEDULE PATIENT	97	11000
045	DEPARTMENT SCHEDULE		10100
002	PATIENT NAME		20100
046	PATIENT SCHEDULE		10100
047	TEST OR TREATMENT ORDERED		10000
035	PREPARATION REQUIRED FOR TEST		10000
012	HOSPITAL NUMBER		00000
960	SET UP TRAYS	02	21002
015	STOCK REORDER POINT		01100
044	LIST OF ITEMS		20100
016	QUANTITY ON HAND		01100

961	DISPATCH COURIER	99	21200
002	PATIENT NAME		20000
034	ROOM NUMBER		00000
040	PATIENT DESTINATION		10000
041	MODE OF TRANSPORTATION		10000
042	SCHEDULED TIME		00000
962	UPDATE PERSONNEL TIME	99	20002
039	EMPLOYEE NUMBER		00000
062	EMPLOYEE NAME		20103
014	CURRENT DATE		00100
036	REGULAR HOURS WORKED		01000
037	OVERTIME HOURS WORKED		01000
963	SCHEDULE EMERGENCY MAINT.	27	21001
020	STATEMENT OF PROBLEM		20100
069	TIME REQUESTED		00100
039	EMPLOYEE NUMBER		00000
084	PERSONNEL LIST WITH QUALIFICATIONS		10100
034	ROOM NUMBER		00100
964	CHARGE DEPARTMENT	02	20302
001	ITEM DESCRIPTION		20000
008	QUANTITY		01000
007	UNIT SIZE		01100
011	DOLLAR AMOUNT		01000
013	DEPARTMENT ACCOUNT NUMBER		00000
965	UPDATE PATIENT SCHEDULE	97	21000
012	HOSPITAL NUMBER		00000
002	PATIENT NAME		20100
047	TEST OR TREATMENT ORDERED		10000
042	SCHEDULED TIME		00000
006	HOSPITAL DEPARTMENT		10000
096	DATE SCHEDULED		00000

966	FILL PATIENT ORDER	02	12002
001	ITEM DESCRIPTION		20100
002	PATIENT NAME		20100
034	ROOM NUMBER		00100
968	FILL DEPARTMENT REQUEST	02	12002
001	ITEM DESCRIPTION		20100
007	UNIT SIZE		01100
008	QUANTITY		01100
006	HOSPITAL DEPARTMENT		10100
969	RECORD PRESCRIPTION	01	10002
002	PATIENT NAME		20100
032	ADDRESS		20100
001	ITEM DESCRIPTION		20100
033	PRESCRIPTION NUMBER		00000
008	QUANTITY		01100
004	DOSAGE SIZE OR QUANTITY		01100
009	PHYSICIAN		10100
011	DOLLAR AMOUNT		01000
014	CURRENT DATE		00100
970	FILL PRESCRIPTION	01	10002
002	PATIENT NAME		20100
032	ADDRESS		20100
001	ITEM DESCRIPTION		20100
033	PRESCRIPTION NUMBER		00100
008	QUANTITY		01100
004	DOSAGE SIZE OR QUANTITY		01100
009	PHYSICIAN		10100
972	RETURN STOCK-CREDIT	99	20003

024	VENDOR NAME	20100
028	PURCHASE ORDER NUMBER	00000
020	STATEMENT OF PROBLEM	20000
001	ITEM DESCRIPTION	20103
026	VENDOR STOCK NUMBER	00100
008	QUANTITY	01000
025	STOCK NUMBER	00000
095	DEPARTMENT ITEMIZED EXPENDITURES	11100

973 SET UP BLANKET 99 20003

024	VENDOR NAME	20000
011	DOLLAR AMOUNT	01000
028	PURCHASE ORDER NUMBER	00000
013	DEPARTMENT ACCOUNT NUMBER	00000
006	HOSPITAL DEPARTMENT	10100

974 GENERATE STOCK LABEL 03 21003

001	ITEM DESCRIPTION	20100
025	STOCK NUMBER	00000
024	VENDOR NAME	20100
015	STOCK REORDER POINT	01100
030	REORDER QUANTITY	01100
031	SHELF NUMBER	00100

975 REQUISITION-INTER DEPARTMENT 99 20202

001	ITEM DESCRIPTION	20003
013	DEPARTMENT ACCOUNT NUMBER	00000
008	QUANTITY	01000
007	UNIT SIZE	01100
011	DOLLAR AMOUNT	01000
026	VENDOR STOCK NUMBER	00000

976 UPDATE FORMULARY 01 20004

024	VENDOR NAME	20000
003	ROUTE OR METHOD OF MEDICATION	10000
001	ITEM DESCRIPTION	20000
029	APPROVAL	12000

007	UNIT SIZE	01000
010	CHARGE CODE	10000

977 REQUEST PRICE QUOTE 99 21002

001	ITEM DESCRIPTION	20000
008	QUANTITY	01000
007	UNIT SIZE	01000
024	VENDOR NAME	20000
032	ADDRESS	20000
006	HOSPITAL DEPARTMENT	10000

978 ORDER ON BLANKET 99 21002

001	ITEM DESCRIPTION	20003
008	QUANTITY	01000
007	UNIT SIZE	01000
024	VENDOR NAME	20100
032	ADDRESS	20100
026	VENDOR STOCK NUMBER	00000
028	PURCHASE ORDER NUMBER	00000

979 INITIATE PURCHASE 99 21002

001	ITEM DESCRIPTION	20000
008	QUANTITY	01000
007	UNIT SIZE	01000
024	VENDOR NAME	20000
032	ADDRESS	20000
026	VENDOR STOCK NUMBER	00000

981 UPDATE INVENTORY-ORDERS 03 20001

001	ITEM DESCRIPTION	20100
025	STOCK NUMBER	00000
008	QUANTITY	01000
007	UNIT SIZE	01100
024	VENDOR NAME	20000
026	VENDOR STOCK NUMBER	00000

982	GENERATE RECEIVING RECORD	03	20001
001	ITEM DESCRIPTION		20100
025	STOCK NUMBER		00000
008	QUANTITY		01000
007	UNIT SIZE		01100
024	VENDOR NAME		20000
026	VENDOR STOCK NUMBER		00000
983	GENERATE ISSUE RECORD	03	20000
001	ITEM DESCRIPTION		20100
025	STOCK NUMBER		00000
008	QUANTITY		01000
007	UNIT SIZE		01100
013	DEPARTMENT ACCOUNT NUMBER		00000
006	HOSPITAL DEPARTMENT		10100
984	REQUISITION STORES	99	22002
001	ITEM DESCRIPTION		20103
025	STOCK NUMBER		00000
008	QUANTITY		01000
007	UNIT SIZE		01100
013	DEPARTMENT ACCOUNT NUMBER		00000
985	RECORD PREPACKAGING	01	20001
018	HOSPITAL LOT NUMBER		00000
014	CURRENT DATE		00100
024	VENDOR NAME		20000
021	VENDOR LOT NUMBER		00000
007	UNIT SIZE		01000
008	QUANTITY		01000
986	RECORD BULK COMPOUNDING	01	20001
001	ITEM DESCRIPTION		20000
008	QUANTITY		01000
022	INGREDIENT		10000

021	VENDOR LOT NUMBER	00000
023	CHECKED BY	10000
024	VENDOR NAME	20000
014	CURRENT DATE	00100

987	COMPILE NARCOTICS AUDIT	01	20005

001	ITEM DESCRIPTION	20000
020	STATEMENT OF PROBLEM	20000

988	UPDATE NARCOTICS LOG	01	20000

021	VENDOR LOT NUMBER	00000
018	HOSPITAL LOT NUMBER	00000
001	ITEM DESCRIPTION	20000

989	TRANSFER NARCOTICS	28	20003

001	ITEM DESCRIPTION	20000
006	HOSPITAL DEPARTMENT	10000
014	CURRENT DATE	00100
008	QUANTITY	01000
018	HOSPITAL LOT NUMBER	00000

990	RECORD NARCOTICS DISCREPANCY	28	20000

001	ITEM DESCRIPTION	20000
014	CURRENT DATE	00100
018	HOSPITAL LOT NUMBER	00000
062	EMPLOYEE NAME	20000
020	STATEMENT OF PROBLEM	20000

991	RECORD NARCOTICS USE	28	20000

001	ITEM DESCRIPTION	20000
002	PATIENT NAME	20000
014	CURRENT DATE	00100
009	PHYSICIAN	10000

004	DOSAGE SIZE OR QUANTITY		01000
017	MEDICATION ADMINISTERED BY		10000
992	CHECK FLOOR STOCK	01	22002
001	ITEM DESCRIPTION		20000
015	STOCK REORDER POINT		01100
016	QUANTITY ON HAND		01100
006	HOSPITAL DEPARTMENT		10000
993	GENERATE LABEL	01	10000
002	PATIENT NAME		20100
001	ITEM DESCRIPTION		20100
009	PHYSICIAN		10100
014	CURRENT DATE		00100
006	HOSPITAL DEPARTMENT		10100
004	DOSAGE SIZE OR QUANTITY		01100
994	CREDIT DEPARTMENT CHARGE	01	20002
010	CHARGE CODE		10000
011	DOLLAR AMOUNT		01000
006	HOSPITAL DEPARTMENT		10000
013	DEPARTMENT ACCOUNT NUMBER		00000
095	DEPARTMENT ITEMIZED EXPENDITURES		11100
995	CHARGE DEPARTMENT	01	20002
010	CHARGE CODE		10000
011	DOLLAR AMOUNT		01000
006	HOSPITAL DEPARTMENT		10000
013	DEPARTMENT ACCOUNT NUMBER		00000
095	DEPARTMENT ITEMIZED EXPENDITURES		11100
996	CREDIT PATIENT CHARGE	01	00000

010	CHARGE CODE	10000
011	DOLLAR AMOUNT	01000
012	HOSPITAL NUMBER	00000
001	ITEM DESCRIPTION	20103

997	CHARGE PATIENT	97	00000

010	CHARGE CODE	10000
011	DOLLAR AMOUNT	01000
012	HOSPITAL NUMBER	00000

998	FILL FLOOR ORDER	01	12002

001	ITEM DESCRIPTION	20100
006	HOSPITAL DEPARTMENT	10100
008	QUANTITY	01100
007	UNIT SIZE	01100

999	FILL PATIENT ORDER	01	12000

001	ITEM DESCRIPTION	20100
003	ROUTE OR METHOD OF MEDICATION	10100
004	DOSAGE SIZE OR QUANTITY	01100
005	FREQUENCY OF MEDICATION	01100
002	PATIENT NAME	20100
006	HOSPITAL DEPARTMENT	10100
009	PHYSICIAN	10100

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BIOGRAPHICAL SKETCH

Clifford Worden McKibbin III was born July 13, 1941, in Lansing, Michigan. In June, 1959, he was graduated from Seminole High School in Sanford, Florida. He entered the University of Florida in September, 1959, and received the degree of Bachelor of Science in Electrical Engineering, with honors, in December, 1963. After entering the Graduate School of the University of Florida in January, 1964, he was employed by the IBM Corporation in April, 1965, and until the present time has worked toward the degree of Master of Science in Engineering.

This thesis was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of that committee. It was submitted to the Dean of the College of Engineering and to the Graduate Council, and was approved as partial fulfillment of the requirements for the degree of Master of Science in Engineering.

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